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NAVAL OBSERVATORY SEEKS NEW LOCATION

PLANS are actively in progress to select a new site for the United States Naval Observatory which will be more suitable for the particular kind of astronomical observations that are necessary in the work required of our national observatory. It was moved to its present site in 1893, from a previous location in Washington which it had occupied for nearly 50 years. Since its removal to the present site, the seeing conditions have gradually deteriorated with the growth of the city until within recent years they have become so unsatisfactory that it has been evident for some time that a move to another location would eventually be necessary.

From time to time during past years this problem has been considered, but no definite action resulted. Recently, the establishment of a large new hospital center in Washington was approved by Congress. The 77-acre tract of land occupied by the observatory was selected as an ideal site for this center, and the Secretary of the Navy was asked to consider the transfer of the property for this purpose. This proposal met with favor, contingent on the approval by Congress of the necessary funds and time being made available for moving to a satisfactory location without interrupting the essential work of the observatory.

It is estimated that about two years will be required to examine possible sites and to determine that one of them is satisfactory. A number of astronomers are now being consulted by representatives of the Naval Observatory to obtain the consensus as to the most desirable characteristics of a new location. The observatory staff is gathering meteorological data and information on other pertinent conditions for different regions. Tentative possible sites will later be investigated by making astronomical observations with portable equipment. Preliminary plans for the new observatory and estimates of the cost of construction and transfer are being prepared. The entire operation of moving the institution will probably take at least eight years, but construction of the hospital center on a part of the present grounds can begin meanwhile. The present observatory buildings will probably not be moved.

To avoid a discontinuity in the fundamental observations, a period of overlap, during which observations will be carried on simultaneously at both the new site and the present location, will be required.

The choice of the new location is limited by the requirements of the highly specialized and peculiarly exacting nature of the work. The observations are almost exclusively those of fundamental positional astronomy. These include continuous series of determinations of the right ascensions and declinations of the sun, moon, planets, satellites, and principal stars, with the highest possible accuracy and independent of any previous measurements, as well as the precise determination of time and of the variation of latitude. Systematic continued observations of this type, extending in an unbroken series over long intervals, are needed to provide the basic constants, planetary tables, and star catalogues which are essential in all branches of astronomy (including the problems of galactic structure and stellar dynamics and many problems of astrophysics), and which are the immediate basis of the practical applications of astronomy to navigation, surveying, and determination of time.

The Naval Observatory is the only observatory in the United States, and one of the very few in the world, where extensive work of this kind is now carried on. In addition, it includes the Nautical Almanac Office, which prepares the **American Air Almanac** and **American Nautical Almanac**, indispensable to navigators; and the **American Ephemeris**, the latter a prerequisite for the other almanacs and essential to astronomers in their technical work. Ninety four annual volumes of the **Ephemeris** have been published.

In addition to possessing the usual characteristics for an observatory site, such as clarity and steadiness of atmosphere and generally favorable weather, a new location for the Naval Observatory must be within a restricted range of latitude, and preferably very near the same parallel as at present. It is essential that the brighter stars be accurately observable in the daytime with the comparatively small telescopes used in transit circles; and the climatic characteristics must be appropriate for the satisfactory performance of the transit circles. Sudden changes in temperature are especially undesirable.

An article describing some of the history and present work of the nation's observatory may be found in The SKY, Vol. V, No. 11, September, 1941.

Sky and TELESCOPE

VOL. VI, NO. 9
WHOLE NUMBER 69

CONTENTS

JULY, 1947

COVER: A photograph of totality during the eclipse of the sun, May 20, 1947, taken by the Cordoba Observatory expedition at Corrientes, Argentina. The exposure time was 1 second at f/11. The top of the picture is toward the zenith at the time of eclipse; south is to the upper right, and north to the lower left, where the short polar streamers may be seen. (See page 3.)

BACK COVER: A portion of the moon near last quarter, from a photograph taken at Lick Observatory with the 36-inch refractor by J. H. Moore and J. F. Chappell. This is Plate XVI in the series of back-cover plates. (See In Focus.)

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Eclipse in South America

Along the path of totality of a very favorable eclipse of the sun, some observers met success while others failed.

PICTURES televised within 61 hours after totality occurred in Brazil on May 20th brought television audiences the complete story of the eclipse at Bocayuva, where four or five expeditions were favored with good weather for this longest total eclipse since the close of the war. Lapse-time motion pictures taken by Leroy G. Phelps, National Broadcasting Company cameraman, speeded up duration of the entire event, from first to last contact, from about 2½ hours to less than a minute.

These films were the first pictures of the eclipse to be shown in the United States. They were flown to New York and processed for broadcasting over the New York-Schenectady-Philadelphia-Washington television network at 9:30 p.m. May 22nd. The speed with which this was done was due largely to a special process whereby films may be televised in negative form, thus eliminating the time-consuming job of positive printing.

One frame of Mr. Phelps' series during totality, considerably enlarged, is reproduced on page 4. It shows the image of the sun as reflected in a coelostat mirror, which was mounted on a concrete pier and driven by clockwork to follow the sun across the sky.

At about 10 minutes after eight o'clock (Eastern daylight time) that Tuesday morning, those listening to the NBC news heard amateur astronomer Ben Grauer broadcast from Bocayuva to the effect that high cirrus clouds coming up from the south had already encroached upon the sun. But this unfavorable aspect of the sky changed with amazing rapidity as totality approached and the eclipse itself was seen in a clear portion of the sky. The partial cloudiness hampered some projects, but Dr. Lyman J. Briggs, chairman of the National Geographic Society's research committee, declared the observations 80 per cent successful. This good fortune counterbalances the poor weather which clouded out the National Geographic's expedition to the eclipse in Brazil in 1940.

Not so fortunate, however, were members of the Skyscrapers of Providence, R. I., who went to Araxa under the leadership of Dr. Charles H. Smiley. A news report tells that neither Dr. Smiley's party nor that of Professor Y. K. Ohman, of Stockholm Observatory, was able to make observations "due to bad visibility." This is the third unsuccessful eclipse expedition in a row for the Skyscrapers, who were also clouded out in Brazil in 1940, and in Canada in July, 1945.

This same news item states that the eclipse was obscured by bad weather in much of South America, but apparently this applied mostly to the partial eclipse, for from the path of totality at Itati, in northern Argentina, we have received a cable reading:

PERFECTLY CLEAR CORONA PROTUBERANCES AND SHADOW BANDS BEAUTIFULLY SEEN FILM AND PHOTOMETRY PARTIALLY SUCCESSFUL —DAWSON

As noted in the April issue of *Sky and Telescope,* Dr. Bernhard H. Dawson was leader of a party of amateur astronomers from the Asociacion Argentina "Amigos de la Astronomia" in Buenos Aires. Theirs was evidently a favored expedition, as were those at nearby Corrientes, where several groups were located.

The camp of the Cordoba expedition at Soto, showing the film camera with a telescopic prism lens (focal length 115 cm.), the coelostat, radio receivers, and a telescope. The tree is an algarrobo.

A message from Dr. Enrique Gaviola, director of Cordoba Observatory, told of unfavorable conditions in the westernmost portion of the path from which we have information:

SOTO CORDOBA CLOUDED. IN CORRIENTES OBSERVATIONS SUCCESSFUL - GAVIOLA

Soto is a village situated near the central line to the northwest of Cordoba itself, which is just outside the southern extremity of the path of totality. We are grateful to Dr. Gaviola for his airmail communication of June 4th, enclosing the picture of totality which appears on the front cover and the pictures of the two Cordoba camps reproduced here. His letter reads:

"I am sending you a preliminary report of our expeditions to observe the eclipse. There were five Argentine astronomical expeditions. Four were stationed near Corrientes and had fair weather: one from La Plata Observatory, one from the Argentine Naval Observatory, one from 'Amigos de la Astronomia,' and one from Cordoba. The fifth one in Soto could only see the darkness of the eclipse increased by the darkness of the clouds covering the sun.

"The La Plata expedition used the 2-prism Hussey spectrographs and a few cameras.

Leroy G. Phelps used a coelostat to direct the sun's image into his camera. Courtesy NBC Television and National Geographic Society.

The expedition of the Cordoba Observatory in "La Arrocera Argentina" in Corrientes. Subdirector Dr. Ricardo Platzeck is in the center; the assistant astronomer, David McLeish, at left; and the first mechanic, Nicolas Hipolito, at right. With the instruments shown, spectra and direct photographs of the solar corona were obtained.

"The Naval Observatory expedition filmed the eclipse with two sound-film cameras, registering the time signals on the sound track. This work was done in co-operation with Professor Bonsdorff, of Helsinki, Finland, with the purpose of determining the distance South America-Africa and the lunar parallax —once the distance Corrientes-Bocayuva is measured by triangulation.

"The group of amateurs led by Dr. Bernhard Dawson had cameras and photometers.

"The subdirector of Cordoba, Dr. Ricardo Platzeck, took with him the reflecting spectrograph (40 angstroms per millimeter), which has an aperture ratio of f/5, and the newly completed nebular Platzeck-Littrow quartz-prism spectrograph with an aperture ratio of f/2. He obtained one good plate of the corona with the first and two with the second. They are being studied now.

"In the picture of the instruments at Corrientes, the instruments are the optical grating reflecting spectrograph (foreground right), the quartz-prism spectrograph (butt visible behind the former), a coelostat (center), and a photographic camera (left). All the instruments but the photographic camera were made in the optical and mechanical shops of the observatory. The sunlight arrives at the instruments after being reflected by the plane mirror of the coelostat and by small secondary plane mirrors. The mirrors are front-surfaced aluminized and reflect visible and ultraviolet light.

"The group that went to Soto (including the writer) took a film camera with double sound track, provided with an objective prism of 115-centimeter focal length, two radio receivers for obtaining time signals, a tuning fork for subdividing the seconds on the film (one second for 60 centimeters of film), a telescope and auxiliary equipment.

"The eclipse had a good press in South America and has no doubt contributed to awaken interest in astronomy in wide circles. All expeditions enjoyed kind hospitality and hearty support of local authorities and people."

Prediction of the appearance of the solar corona during the eclipse had been made using observations received via the U. S. Army from observers with the coronagraph at Wendelstein, Germany. The observations there were made about two weeks (half a solar rotation) before the eclipse, at a time when our coronagraph at Climax, Colo., was handicapped by unfavorable weather. Assuming little change in the general coronal features during the half rotation interval between the observations and the eclipse, a mirror image of the earlier appearance might have been expected at totality. As released by Science Service, the first prediction read:

"On the eastern edge, there will be a narrow, bright spike visible through telescopes. It will appear about 40 degrees north of the sun's equator. South of the equator, on the east side, will be another bright area. The third bright region will be a streamer from the corona on the west side south of the equator."

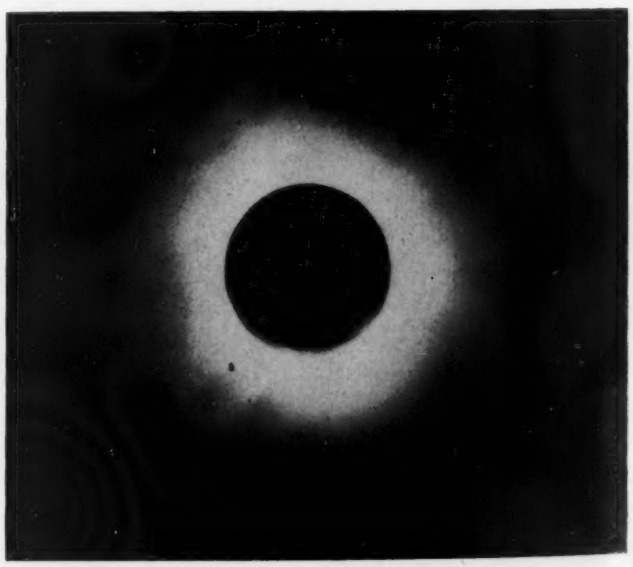
This description refers, presumably, to the inner corona, for which we have no pictures nor reports of observations at this time to determine how closely the predictions were borne out.

ANTI-SOLAR RAYS

A fine example of anti-crepuscular or anti-solar rays was observed by the editors about half an hour before sunset on April 27th, from points on the highway from Manchester to Nashua in New Hampshire. The sky was at least half covered by a long, dense layer of stratocumulus which completely obscured the sun and stretched overhead to the east. In the east, where portions of the sky were clear, alternating light and dark bands converged on a point just beneath the horizon and directly opposite the sun. The bands were of varying widths and corresponded closely with the shaded portions of isolated patches of cumulus clouds.

Where the rays were best observed the sky was hazy, possibly still quite humid from the passage of a cold front which that afternoon produced heavy frontal showers over most of New England.

Readers are referred to page 17, No. 49, **Sky and Telescope**, November, 1945, for an explanation of anti-solar rays by Dr. Charles F. Brooks, of Blue Hill Meteorological Observatory.



This picture of the eclipse was taken by motion-picture camera for television use. Photo by Leroy G. Phelps, National Broadcasting Co.

NEWS NOTES

By Dorrit Hoffleit

VARIABLE-STAR PERIODS

"An astronomical tyro searches in vain through the literature for a detailed report on the standard practice, so it has seemed advisable to report systematically on the procedure." So writes the Rev. Walter J. Miller, S.J., in the introduction to his treatise, "On the Periods of Variable Stars," published as Vol. I, No. 12, of *Ricerche Astronomiche* by the Vatican Observatory.

If you are a novice interested in determining the periods of variable stars from scattered observations, you will find complete instructions and illustrations here. While little that is actually new is given, this is the first complete account suited to the uninitiated. Particularly valuable is the discussion on spurious periods, which may arise when successive observations are made at nearly equal time intervals. An analogy is the stroboscopic study of running machinery: under certain conditions the machinery studied under intermittent illumination may appear to be running backward. Valuable tables are given to assist in the analysis for spurious periods.

COSMIC RAYS AND CANCER

Do cosmic rays influence health? In view of the low intensity of such radiation reaching the earth's surface, it would seem that the effects, if any, should be negligible. Nevertheless, Dr. Frank H. J. Figge, of the University of Maryland Medical School, felt that experimental evidence, in particular as regards cancer, should be obtained. The most desirable experiments would involve studying the differences developing in experimental animals completely shielded from cosmic radiations and those normally exposed to them. Complete shielding, however, is well-nigh impossible. Either a lead roof 49 feet thick or a laboratory 700 feet underground would be necessary. Instead, Dr. Figge sought to intensify the effects of cosmic radiation by the production of cosmic-ray showers.

It is known that when cosmic rays pass through thin layers of lead, these showers are produced. The optimum thickness for small showers is 0.6 centimeters, and for large ones about two centimeters. In Dr. Figge's experiment, 184 male mice were uniformly injected with the cancer-inducing chemical, methylcholanthrene, and then distributed in eight cages. Quarter-inch plates of lead were placed over all but three of the cages, but the cages were arranged so that the various groups of mice would be differently exposed to the scattered cosmic rays, during the five months of experimentation.

Although the report in *Science* (Vol. 105, page 323) emphasizes the provisional character of the results obtained, they are stimulatingly significant. Having been injected as they were, the mice should all eventually have developed cancerous tumors. Those mice exposed normally (where the rays could not pass through the spray-producing lead plates) developed tumors after an average latent period of 11 weeks, while the mice exposed to showers had an average period of only 8.5 weeks. At the end of 10 weeks only 22 of 66 of the normally exposed mice had tumors, compared with 84 out of 111 of those exposed to the showers.

If future experiments should confirm these indications, the implication would be that cancer (in people susceptible to it) cannot be prevented since cosmic rays cannot be avoided. While the direct radiation is less effective than secondary showers, its effect over a lifetime would be cumulative. As for the increased effect of the showers, the architects of the future may be called upon to help hold the development of cancer to a minimum by their choices of building materials and dimensions so as to minimize the intensified effects of cosmic-ray showers produced in the structures in which we live and work.

PHOTOGRAPHIC EXHIBIT

For the past two years the Photographic Society of America has devoted a part of its annual exhibition to an exhibit of scientific and technical photographs. Over 200 prints were hung in this technical section in 1946, and from these a traveling show of about 50 prints was made available to technical societies and camera clubs.

This year the exhibition will be hung at the Oklahoma Art Center, Oklahoma City, and contributors are invited to submit prints for the technical section prior to September 8th. The subject matter may cover any phase of technical photography save pictorial photographs of technical and mechanical operations. Scientific and industrial photographs illustrating original and novel photographic techniques may be submitted. These include photographs in such fields as astronomy, geology, medicine (except diagnostic radiographs), metallography, mineralogy, and physics. Both black-and-white and color photographs are acceptable.

Technical data pertaining to each photograph should be lettered neatly in the lower left-hand corner of each mount, if possible, and the maker's name should appear on the face of the mount. There is no limit to the number of entries which may be submitted by a competitor. Prints should be packed securely and mailed to W. F. Swann, 343 State St., Rochester 4, N.Y.

NEW USES FOR TELESCOPES

A new method in medical teaching will involve telescopes and binoculars if an experiment tried recently in Los Angeles is imitated. A doctor performed a delicate operation on the eye of a pig while 17 doctors 25 feet away watched through 20-power sportsman-type telescopes mounted on camera tripods. The technique was devised by the Los Angeles Osteopathic Academy of Ophthalmology and Otolaryngology. Dr. E. W. Davidson, performing the operation, commented, "By using the telescopes, the audience can see, at a distance, better than would be possible if they could all be at the surgeon's elbow."

MORRISON PRIZE

The New York Academy of Sciences announces a prize offered by A. Cressy Morrison, to be awarded in December, 1947. Five hundred dollars will be given for the paper adjudged by the council of the academy to be the most meritorious contribution on the subject of the source of solar and stellar energy. Most recently, this prize was awarded in 1938 to Hans Bethe for his paper on "Energy Production in the Sun," and in 1940 to R. E. Marshak and Hans Bethe for "The Sources of Stellar Energy."

In announcing the current contest, the academy states that the complete answer to this problem has not yet been given. For example, no final model for the sun, properly satisfying the observed luminosity and the hydrodynamical considerations, has been published, and only a start has been made on the problems of the red giants, sub-dwarfs, and white dwarfs.

LIQUID-FUEL ROCKETRY

Twenty-one years ago the first liquid-fuel rocket traveled a distance of 184 feet at a speed of 60 miles an hour, powered by liquid oxygen and gasoline. It was fired at Auburn, Mass., by Dr. Robert H. Goddard, "American founder of the entire modern field of rockets and jet propulsion," according to a note from G. Edward Pendray printed in the April issue of the *Bulletin* of the American Meteorological Society.

Under grants from the Smithsonian Institution and the Guggenheim interests, the late Dr. Goddard established a large rocket development station near Roswell, N. M., where he developed in working order "virtually every feature of long-range liquid-fuel rockets later produced on a big scale by the Germans." One prewar Goddard rocket, only nine inches in diameter and 12 feet long, had features almost exactly like those of the V-2.

New England Field Trip

By George V. Plachy, secretary
Amateur Astronomers Association, New York

A portion of the visiting group gathered in front of the Van de Graaff generator at Massachusetts Institute of Technology. Photo by the author.

AUTOMOBILES and a chartered bus transported 75 members of the New York City Amateur Astronomers Association on a three-day holiday tour of some of New England's institutions of science and culture. Leaving the Hayden Planetarium on Friday morning, May 30th, the group arrived at Cambridge, Mass., late that afternoon. Those traveling by automobile were in time to make a daylight inspection of the Cambridge headquarters of Harvard College Observatory, and to hear Miss Simone Daro describe the nature of her observations and measurements as a graduate student of astronomy at Harvard.

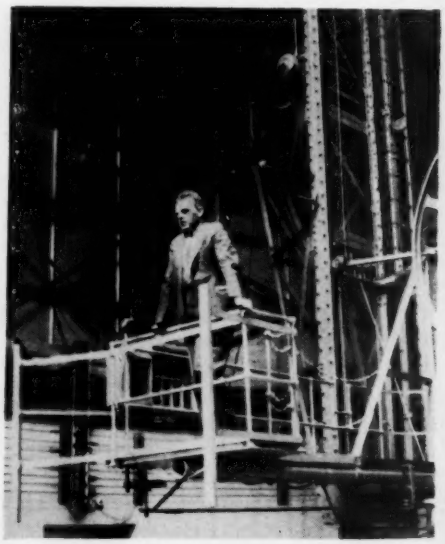
After the entire party had enjoyed a long-anticipated evening meal, the New York amateurs participated in a special meeting of the Amateur Telescope Makers of Boston at the observatory. Greetings from the A.T.M. president were followed by a fascinating talk on "Matters of Telescope Interest," by Dr. James G. Baker, co-author of the book, *Telescopes and Accessories.* Refreshments were served by the A.T.M.'s after the lecture, and by observing through the famous Harvard 15-inch refractor the New York group heralded the centennial of the operation of this instrument. Several of the Boston amateurs set up their reflectors on the adjacent lawns and assisted the visitors in observing various celestial objects in a perfect sky.

Saturday morning, Massachusetts Institute of Technology was host for the inspection of its spectroscopic laboratories and its Van de Graaff (high-voltage) generator. Under the guidance of graduate student R. McDonald and Charles A. Federer, Jr., the varied array of spectroscopic equipment was carefully inspected, including a mercury-arc spectrum produced by one of the long-focus gratings, and apparatus for the study of infrared and Raman spectra. Especially interesting was a complicated device developed by Dean George R. Harrison for the rapid scanning and photometric recording of absorption spectra. With this device the details of a spectrum extending from 2000 to 10,000 angstroms can be recorded in about 90 seconds.

The Van de Graaff generator is the same apparatus as pictured on the front cover of *Sky and Telescope* for November, 1945. Its normal function is to produce for research purposes a very steady stream of ionized particles, either positive or negative, of relatively high voltage, but on the occasion of this visit its enormous spheres were charged to a higher potential than normal and discharged by a spark allowed to pass between them and the walls of the enclosing structure. In a specially built cage inside the structure, in total darkness, the visitors observed the resultant bolts of "lightning," each representing a discharge of 2½ million volts, and accompanied by loud claps of noise.

This demonstration was furnished by E. A. Burrill, Jr., and stimulated appetites for a luncheon in the vast hall of the Walker Memorial building, alongside the Charles River. En route to Harvard's Oak Ridge station Saturday afternoon, astronomical interests temporarily changed to historical, as the groups made brief visits to the Revolutionary shrines at Lexington and Concord.

The observatory, which is located in the town of Harvard, Mass., was reached at 3:30 p.m., when from the observing platform of the awe-inspiring 61-inch reflector Dr. Bart J. Bok greeted the party in his own inimitable manner. The generous co-operation of several graduate students made possible the detailed inspection of observing instruments. The 16-inch, 12-inch, and 8-inch refractors, together with the patrol cameras, gave an insight into the vast sky-surveying program proceeding silently and efficiently on the summit of well-named Oak Ridge.

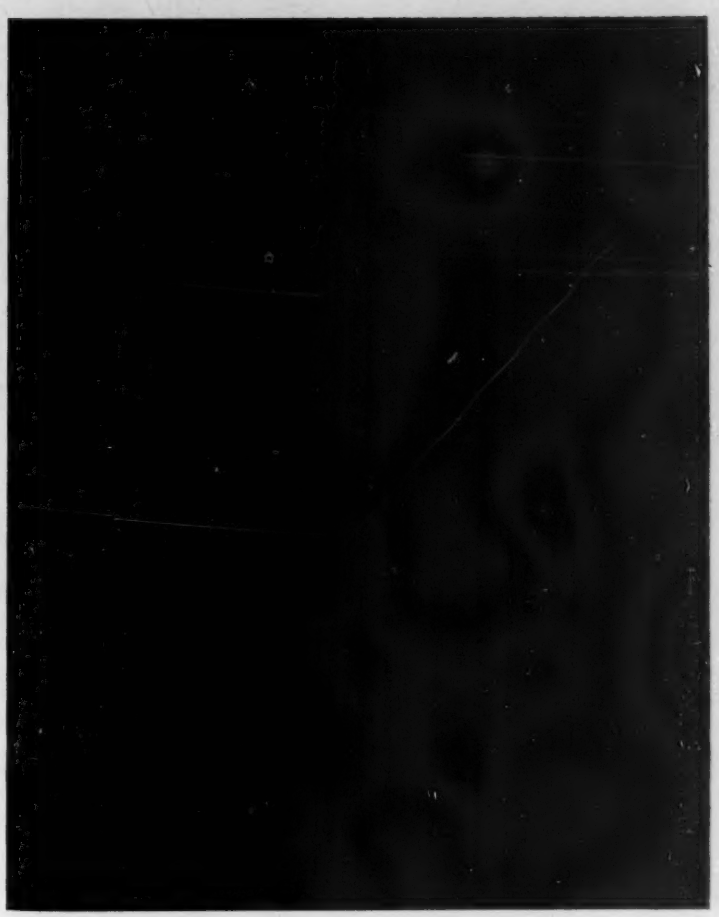


From the observing platform of Harvard's 61-inch reflector (above), Dr. Bart J. Bok greeted the visiting amateurs gathered on the floor of the 61-inch building. Photos by the author.

At Harvard's seismological station on this same hilltop, a program correlating microseismograms with meteorological forecasting is being directed by Dr. L. Don Leet. Here the group examined

(Continued on page 15)

An Unusual Meteor Photograph



A meteor of the Draconid shower of October 9th, last year. Photo by members of the Jacksonville Amateur Astronomers Club. Engraving, courtesy "Popular Astronomy."

DURING the shower of Draconid meteors on October 9th last year, many amateurs obtained photographs of one or more meteors on the same negative. Reports have been received that a few of these meteor trails show remarkable curvature. At Harvard College Observatory, Carl Bauer has made a special study of a negative bearing a meteor trail with conspicuous sinuous curves. This negative was taken by the members of the Jacksonville Amateur Astronomers Club. The picture and Mr. Bauer's conclusions concerning it appear in the latest issue of **Popular Astronomy.**

Undulations, spirals, or abrupt curves in the motion of meteors require large lateral accelerations which appear impossible from physical considerations. Visual impressions of such motions may be explained by errors in perception, splitting of a meteor, fluctuations of brightness, or by second independent meteors, but a photograph such as that procured by the Jacksonville amateurs presents a definitely recorded observation which must have some adequate explanation.

The star trails in this picture show two breaks which E. L. Rowland, Jr., of Jacksonville, explains as resulting when the slide was temporarily inserted after the operator of the camera observed a bright meteor crossing the field of the camera. Microscopic examination of the trail of the bright star Deneb reveals the presence of a faint, fine curved line at the beginning of the trail and at the second break. In both cases, this fine line merges into the ordinary trailed star image and indicates that the camera must have vibrated with an elliptical motion. The fine line appears to be continuous across the second break and thus the slide apparently was not inserted at this time. The vibrations were rapid and quickly damped, lasting a total of about two seconds both times. Measures on the meteor trail indicate that the meteor traveled very nearly the same linear distance during each vibration cycle; for this result, it was necessary to take into account the orientation of the radiant, trail, and camera, and the change in scale from the center to the edge of the film.

As these results require that the meteor appeared during one of the brief intervals when the camera was vibrating, and as the observing group did not have the impression that the meteor occurred at these times, Mr. Bauer has considered the consequences of interpreting the trail as representing a real curved motion of the meteor. He calculates that the lateral acceleration required to produce the observed trail is about 10,000 times the acceleration of gravity and about 100 times the measured decelerations of meteors in the forward direction due to the resistance of the earth's atmosphere. These decelerations are usually of the order of one kilometer per second per second and are very rarely as high as 10 kilometers per second per second except near the ends of trails. The lateral accelerations which have previously been determined for photographic meteors have amounted to several times the acceleration of gravity, and ordinarily 100 times gravity should be a high upper limit for lateral accelerations, which must be caused by the interaction of the atmosphere with a particle of irregular shape or structure.

Mr. Bauer further points out that in the case of the trail in question, it would be almost impossible to maintain that the meteor could persist in the same type of relatively uniform oscillations through 12 cycles while it was constantly changing its shape and mass due to its disintegration in the earth's atmosphere. "Consequently," he states, "even if there were an absence of other explanations for the shape of the trail, the sinuous trail could not be interpreted as representing the true motion of the meteor."

Another interesting appearance was found in the study of this picture. For several cycles near the middle of the trail, there is a gradual shading off of the trail in the direction from which the meteor came. This appearance is attributed to the train of hot luminous gases in the wake of the meteor. Due to the component of vibrational motion at right angles to the direction of motion of the meteor, the images at the nodes of the sinuous curve are effectively instantaneous photographs of the meteor and the luminous gases in its wake. This appearance is not compatible with a real sinuous motion of the meteor, for in such a case the luminous gases would be left along the path the meteor traversed. This appearance emphasizes, Mr. Bauer points out, that we should not consider a meteor as a moving point source of light but must take into account the light from the luminous gases in its wake. This phenomenon is an important limiting factor in the design of rotating shutters for meteor cameras.

As for visual observations of meteors with sinuous paths, if such phenomena did occur, undulations might well be expected to reach only 10 seconds of arc in total range, which certainly could not be observed with the naked eye or on small-scale photographs. Visual observations of paths showing moderate curvature are not excluded by this result.

PROBLEMS IN ROCKET DEVELOPMENT

Those interested in the theory of rocket propulsion and design will find a comprehensive article by J. Humphries in the March issue of the *Journal* of the British Interplanetary Society (Vol. 6, No. 4). He discusses in turn fuels, the rocket motor, and the fuel-supply system, and concludes that in the use of better fuels lies the greatest hope for increasing rocket efficiency. All fuels containing hydrogen, carbon, oxygen, and nitrogen produce combustion products which dissociate so rapidly above 2,500° centigrade that they limit the attainment of temperatures at which these fuels are most efficient. Metallic oxides and fluorides may possibly be used in the future.

The British Interplanetary Society has its headquarters at 1 Albemarle Street, Piccadilly, London, W. 1.

Amateur Astronomers

Leslie C. Peltier Receives Honorary Degree

At the June 12th commencement of Bowling Green State University, Ohio, an honorary degree of doctor of science in astronomy was awarded to Leslie C. Peltier, of Delphos, world-famous amateur. He is the discoverer of 10 comets, for each of which he has received a Donohoe medal from the Astronomical Society of the Pacific. He is also one of the high-ranking observers for the American Association of Variable Star Observers and is credited with the independent discovery of two novae. He was the recipient of the first AAVSO merit award, and last fall was presented a scroll recognizing him as one of the 20 members of the association who had contributed more than 10,000 toward the first million observations made by the American Association of Variable Star Observers.

Peltier was born January 2, 1900, and was educated at the Delphos high school. He first became interested in variable star work through reading Olcott's *Field Book of the Stars*, and he joined the AAVSO in January, 1918. In nearly 30 years of continuous observing, he has over 70,000 observations of variable stars to his credit.

He observes with a 6-inch comet seeker lent to him through the AAVSO by Princeton University. The citation on the merit award made in 1934 still holds true: "His faithful and untiring service has placed him in the front ranks of variable star observers, and his discoveries have won him international fame."

Leslie C. Peltier at the door of his observatory in Delphos, Ohio.

Amateur Astronomers League Elects Temporary Council and Officers

In accordance with its by-laws, the Amateur Astronomers League, which now has 30 organization members, has elected a temporary national council of the following persons:

Wendell Brant, San Diego, Cal.; C. A. Federer, Jr., Cambridge, Mass.; Carl H. Gamble, Moline, Ill.; E. A. Halbach, Milwaukee, Wis.; Herbert Harris, Portland, Me.; Neal J. Heines, Paterson, N. J.; Harlow Shapley, Cambridge, Mass.

These in turn have elected temporary officers, bringing the total membership of the temporary national council to nine: Dr. Shapley, national president; Mr. Halbach, national vice-president; Mrs. Margaret Back, Detroit, Mich., national secretary; and Miss Mabel Sterns, Washington, D. C., national treasurer.

Some of the principal problems which will be considered at sessions of the League at the Amateur Astronomers Convention in Philadelphia this month are the formation of regions, provision for membership at large by individuals, revision of the by-laws, incorporation of the League, junior group memberships, establishment of observing and other activity sections. There will also be election of permanent national officers by the delegates of the member organizations.

Those groups wishing information concerning membership in the Amateur Astronomers League should communicate with Mrs. Back at 168 Vendome Ave., Grosse Pointe Farms 30, Mich.

THIS MONTH'S MEETINGS

Chicago: The Burnham Astronomical Society will hold its annual observation party and barbecue on Saturday, July 26th, at the home of Mr. and Mrs. H. C. Torreyson, Prospect Heights, Mt. Prospect, Ill. Non-members are invited, and should communicate with J. Madison Showalter, 6200 Kenmore Ave., Chicago 40, Ill.

Indianapolis: The Indiana Astronomical Society will visit and meet at the Goethe Link Observatory, Brooklyn, Ind., on Sunday, July 6th. "Observation" will feature the program, conducted by Victor Maier.

Kalamazoo: The Kalamazoo Amateur Astronomy Association, on Saturday, July 19th, will hear a talk on "Astrophysics," by H. V. Hilker, at the home of Mr. and Mrs. Max Kester, 1928 Brook Drive.

Philadelphia Convention

The schedule of activities for the July 4th weekend convention at Philadelphia remains substantially as announced in the June issue, with the exception of plans for Saturday evening. The revised schedule calls for a banquet in Franklin Hall at the Franklin Institute at 5:30 on Saturday, cost $2.50. Then at 7:30 p.m., buses will leave the planetarium entrance for the trip to Haverford, where the evening program of activities will be as already announced.

Sunspot Observers Plan Meeting at Milton Academy

In conjunction with the work of the solar division of the AAVSO, amateur astronomers (and professionals) interested in sunspot observing are invited by Dr. A. E. Navez to attend a meeting at the Milton Academy Observatory, Milton, Mass., on Saturday, July 12th, where observations of the sun itself will begin at 10:30 a.m. Those attending are asked to bring their solar observing equipment and to make use of the observatory's three clock-driven telescopes.

From the resulting exchange of direct information on methods of observing and equipment, it is expected to answer some of the questions which bother many amateurs, such as: What markings should be counted as sunspots? How should a group be determined? What equipment is most suitable? How can we improve equipment and observing methods?

Milton Academy is about seven miles south of Boston, on Route 28. The meeting will open at 9:30 a.m. in the science building (Warren Hall) at the corner of Randolph Ave. and Center St. A group luncheon may be arranged if there is sufficient desire for it. Tentative plans are made to visit Dr. H. T. Stetson's Cosmic Terrestrial Research Laboratory at Needham, Mass., in the afternoon. Those interested in further information about this program should address Dr. A. E. Navez, Milton Academy, Milton 86, Mass.

Memorial Award Winner

The winner of the Seymour Schinasi Memorial award to an outstanding member of the Junior Astronomy Club was announced at the May 23rd meeting of the club, in New York City. This year's award, a Skyscope telescope, was made to Kurt Kohn, who was cited for leadership of the Discussion Group, instructing of the class in general astronomy for 1946-47, and for his work on the Junior Astronomy *News*, of which he has recently been appointed editor.

Honorable mentions were given to Edward Epstein, Donald Hirsch, and Gerhard Rayna.

The Mahoning Valley Astronomical Society will continue meeting through the summer months, June through September, on the first or second Sunday of each month.

Our club membership numbers 36, and includes our wives, which we have found by past experience has been a controlling factor in making the club both an enjoyable and a firm organization, since the women take as active a part in the proceedings as the men. The members are rather widespread, coming from Trumbull and Mahoning counties, with practically every member attending each meeting. Telescope making has a firm root, with many instruments built or in progress. There are seven reflectors completed and working, ranging from three 6-inch ones to a 16-inch, and there are two 4-inch refractors completed and working. Six more reflectors and one refractor are in the process of construction.

STEPHEN A. HOYNOS, secretary-treasurer
1574 Sheridan St., N.E.
Warren, O.

Here in Rocky Mount, N. C., we have recently organized a club on astronomy. The first meeting was held on May 16th at the YMCA. The group was started by the Rev. Lanier, pastor of a Baptist church here. We began with six members, and since have had three meetings and boast a total of 15 members. The club is being made a project of the Hi Y's and the YMCA, and we have named it the Hi Y Astronomy Club. Of course it is open to all who are interested.

CHARLES WILLIAMS, president
1301 Branch St.
Rocky Mount, N. C.

The New York Amateur Astronomers Association, which recently celebrated its 20th anniversary, held its annual members' meeting at the American Museum of Natural History on May 21, 1947. The program combined association business with astronomical motion picture entertainment.

At this meeting the following members were re-elected to the Board of Directors: Miss Jane S. Davis, Wallace W. Benjamin, Mrs. Virginia Geiger, William Henry, Mrs. Lois Lee, George V. Plachy.

Secretary Plachy reported increases in the past two years of approximately 35 per cent in membership, 56 per cent in attendance at lectures, and seven per cent in attendance at classes in astronomy conducted by the association. Henry T. Kirkebye, the treasurer, reported that the society was in sound financial condition.

Reports were also given by Miss Marion L. Louis on the field trips and other activities planned during the past year by the Special Events committee; by the association's staff editor, Miss Davis, on the Astronomical News Service; and by the Optical Division chairman, Richard S. Luce, on the work of that unit.

The meeting was concluded with the showing of astronomical motion pictures, including a film of solar prominence activity made at McMath-Hulbert Observatory, and a film concerning the 200-inch telescope at Mount Palomar.

JANE S. DAVIS
Assistant secretary, AAA
Hayden Planetarium, N.Y.C.

A merger of two recently started astronomy clubs in Columbus has just been effected, and we are happy to inform you that there is now one astronomy group in this city. Meetings are held on the last Tuesday of each month in the McMillin Observatory of Ohio State University, at 8:00 p.m. Our society plans to combine three functions in one, by serving those generally interested in astronomy, the observers, and the telescope makers. We have so far only a temporary slate of officers, but already there are 50 members.

J. ALLEN HYNEK
McMillin Observatory
Columbus 10, O.

The Amateur Astronomers Society of Norfolk, Va., has now gone back to its prewar schedule of conducting two meetings monthly, the first devoted to regular business and science study and the second to observations only. Meetings are on the second and fourth Thursdays.

The society held its annual outing on May 25th at Virginia Beach, with 23 members and guests present. Observing was poor due to stormy conditions.

P. NASH ANDERSON, president
635 W. 29th St.
Norfolk, Va.

The Schenectady Astronomy Club is again active after suspension of meetings during the war. Meetings are held on the third Monday of every month at the Schenectady Museum, at 8 o'clock. Two telescopes of six inches aperture have been donated to the museum for use of the astronomy group, one by Howard Maxwell and the other by the writer.

Four members are making 95-mm. refractors by a method which involves the use of optician's metal tools for grinding and polishing; the final correcting is done by hand on regular pitch laps. An 8-inch f/3 Schmidt camera is also under construction by H. Vogel and myself. The mirror was ground by Mr. Maxwell on a grinding machine of his own design. It is expected that this project will be completed some time this summer.

Our officers are E. C. Vroman, president; E. L. Judkins, recording secretary and treasurer; Miss B. Dyer, corresponding secretary; and the writer, program chairman.

GEORGE STAFFA
32 Front St.
Schenectady, N. Y.

Exhibits at Palo Alto

During the 10 months beginning September 1st, last year, various astronomical exhibits were displayed at the city library of Palo Alto, Cal. The originator of the plan and the one who secured and arranged the exhibits was Dr. Audley O. Sanders, a local physician who is a telescope owner and an astronomy enthusiast.

The displays were changed each month. The first was an ingenious model of the solar system constructed by Dr. Sanders himself. During October, meteorites were shown from his own collection and from other sources, including the University of Oregon. The displays during other months were principally fine astronomical pictures by J. F. Chappell and astronomers at Lick Observatory. These pictures, many of them 14 x 17 inches, usually dealt with a single subject each month, and very complete descriptions were placed beside each picture.

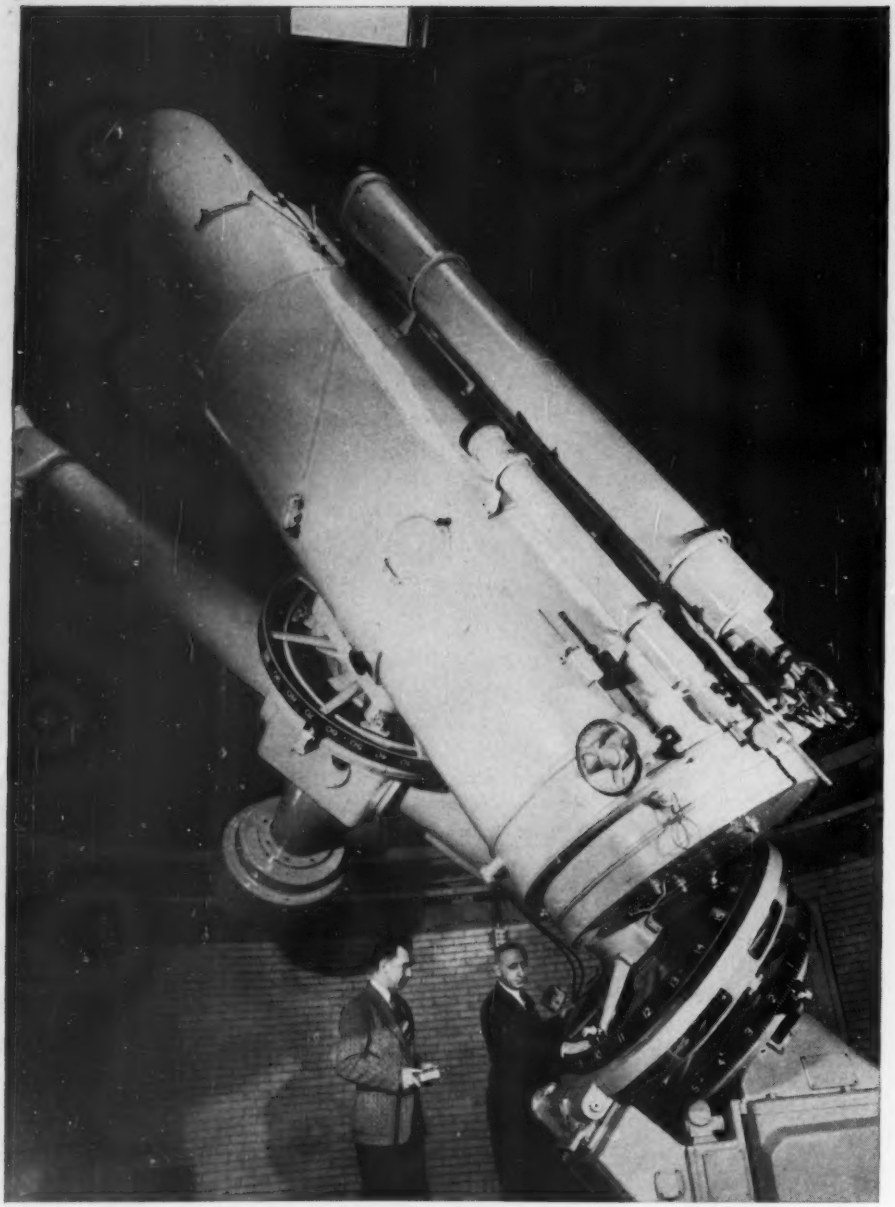
The Palo Alto Astronomy and Telescope Club meets in the Junior Museum of the Community Center on the first and third Fridays of each month in the year at 7:30 p.m. The secretary-treasurer is Marvin J. Vann, of 301 Oxford Avenue.

Ohio Amateur Dies

From W. M. Whitley, corresponding secretary of the Key West Astronomy Club, we learn of the death of Joseph P. Gillis, of Martin's Ferry, Ohio, on May 19th, at the age of 76. He exhibited his own telescope at the Cranbrook convention of amateur astronomers last year, and was awarded first prize in the telescope division. Mr. Whitley had heard that Mr. Gillis had started work on a 10-inch reflector, which may not have been finished before his death.

A Silver Anniversary in Cleveland

By David Dietz, *Science Editor*
Scripps-Howard Newspapers



Dr. J. J. Nassau (right) and Dr. Carl K. Seyfert at the controls of the Schmidt telescope of the Warner and Swasey Observatory.

CLEVELAND'S astronomical society came into existence as a result of a conversation in February, 1922, between Dr. J. J. Nassau and two Cleveland businessmen who were enthusiastic amateur astronomers. They were Albert F. Schroeder, who had previously presented a telescope to one of the branches of the Cleveland YMCA, and Curt B. Mueller.

A preliminary meeting of interested citizens was held at the University Club on March 13th, and the society was formally organized at a subsequent meeting on April 10th. On May 28, 1922, it received its charter from the State of Ohio as a corporation not for profit.

To celebrate its 25th anniversary, the Cleveland Astronomical Society has established a fellowship at the Warner and Swasey Observatory of the Case School of Applied Science. This fellowship is to be held preferably by a European astronomer, and its present holder is Dr. G. B. van Albada, of the University of Amsterdam. Dr. van Albada is now residing at the observatory and making plans to bring his family to Cleveland next year.

It was 26 years ago that a slim, quiet-spoken young man of 28 arrived at Case School to assume the post of associate professor of mathematics and astronomy. That "and astronomy," and a beautiful but small observatory housing a 9½-inch refractor which formerly stood in the back yard behind the adjoining houses of Ambrose Swasey and Worcester R. Warner, constituted the extent of astronomy at Case School in the year 1921.

The observatory atop a hill in East Cleveland, although built of tapestry brick, came as close to an ideal ivory tower as any savant ever hid in. But hiding in an ivory tower held no attraction for young Dr. Nassau. His enthusiasm for astronomy was something to be shared with the greatest number of people. He began by arranging monthly public nights at the observatory, a custom still continued, and by organizing the Cleveland Astronomical Society.

From the beginning the membership of the society included men and women from many walks of life: lawyers, doctors, businessmen, college professors, school teachers, and students. Among the number were several who owned excellent small telescopes and a considerable group interested in amateur telescope making.

The first activity embarked upon by the new society was a series of monthly meetings to hear lectures on astronomy. These have continued, with the exception of the summer months, from that day to this. Many distinguished astronomers from all parts of the country and from Canada have been brought to Cleveland to address meetings of the society.

A series of magnificent gifts, totaling about $150,000, made possible the enlargement of the Warner and Swasey Observatory in 1940. The new additions included a 36-inch Schmidt-type telescope and a lecture hall seating 128 persons. Upon Dr. Nassau's invitation, the enlarged observatory became the permanent home of the Cleveland Astronomical Society. Place was made for the society's library, for telescope-making activities, and opportunity was afforded to use the observatory's technical library and exhibits, and to look through the observatory's various telescopes on meeting night.

For many years James L. Russell, an attorney, has served as vice-president of the Cleveland Astronomical Society. He is the city's leading amateur telescope maker, and under his guidance and encouragement Cleveland has become an important center for amateur telescope makers. Prior to the war, they formed a large group, and now this activity is resuming its old tempo.

Another society project in which Mr. Russell has played an important part has been the annual star-gazing parties staged jointly by the Cleveland *Press* and the society. The writer dreamed up the idea 18 years ago, and these events have been held annually ever since. Readers of *Sky and Telescope* may recall that a photograph of one of these parties appeared on the cover of the October, 1944, issue, which included a detailed report of the parties of that summer.

Briefly, this is the idea: Under Mr. Russell's direction, members of the society bring their telescopes to a designated public park on the agreed night. For several weeks in advance, thanks to Editor Louis B. Seltzer, the *Press* has been promoting the event with announcements, photographs, and feature articles. Everyone is invited to come and look at the moon and whatever planets are on view.

A public address system is set up, and lectures on astronomy are given to the crowd waiting to look through the telescopes. Dr. Nassau, other members of his staff, Dr. Paul Annear, of the Burrell Observatory of Baldwin-Wallace College, Dr. O. L. Dustheimer, and the writer have taken turns at the microphone. As an innovation last summer, a movie screen was put up and sound movies of astronomical subjects were shown.

These parties have been amazingly popular, drawing from 5,000 to 10,000 persons each evening. Usually two or three are held in each summer.

At the present time the society has 160 members, and we look forward to reaching a goal of 200 in the not-too-distant future. Were Dr. Nassau, to whom the society owes its founding and growth, writing this article, he would probably have devoted much of it to telling of the importance of the society in the development of the Warner and Swasey Observatory. For the Cleveland Astronomical Society has created the intellectual climate in which scientific ventures can prosper.

Amateur astronomers operate telescopes for observers at a Cleveland star party.

In Focus

ANOTHER strip of the last-quarter moon is completed by this month's chart, which features large sea areas, and several mountain ranges. Portions of this region appeared on Plate XIII and on Plate XV, and descriptions of some of the features identified here may thus be found in the April and June issues. Many identifications close to the limb are only approximate. Different illumination or a different libration will make these features easier to observe.

All named features are on the accompanying chart, with identifications and spellings after the International Astronomical Union's **Named Lunar Formations,** by Blagg and Mueller. Biographical information is from the British Astronomical Association memoir, **Who's Who in the Moon.**

Aristarchus. The Greek astronomer of this name (c. 310-230 B.C.) is famed for his belief in a sun-centered solar system. This is one of the brightest spots on the moon, a deep crater nearly 30 miles across, difficult to identify on this photograph.

Carlini. A distinct, though small crater, named for Francesco Carlini, for many years director of the Milan Observatory. In 1821 he climbed Mont Blanc to determine the variation of gravity with altitude by measuring the length of a seconds pendulum.

Condamine. Charles Marie de la Condamine (1701-1774) was a French astronomer and physicist. He took part in the expedition with Godin and Bouguer to Peru in 1735 to measure an arc of the meridian near the equator. This work, when compared with similar studies made by Maupertuis in Lapland, confirmed Newton's theory of the flattening of the earth at the poles. On the moon, Bouguer, Condamine, and Maupertuis have been grouped near each other by Schroeter, while Godin (Plate V) has also been honored on the moon by the same selenographer.

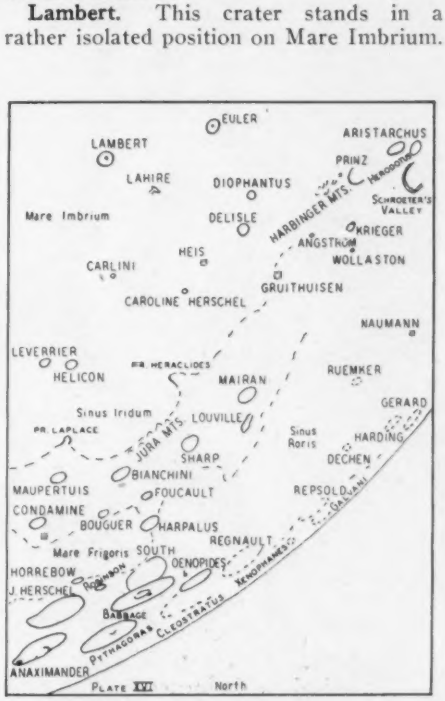
Euler. A 19-mile crater which seems to be somewhat elliptical, with a bright mountain in its center. A number of individual mountains are southward from it (see Plate XV). Leonhard Euler (1707-1783) was a Swiss mathematician who worked under Bernouilli at Basle, and later taught at St. Petersburg and at Berlin. His name is still used to identify several formulae. His work on lunar theory enabled Tobias Mayer (who is commemorated southward from Euler on the moon) to construct his lunar tables, the first practical means for finding longitude at sea.

Harbinger Mts. This range was so named by Birt as these mountains are harbingers of dawn on Aristarchus.

Heis. Eduard Heis (1806-1877) studied under Argelander, and later did valuable observational work. Many amateur and professional astronomers today are familiar with the Heis star atlas.

Caroline Herschel. Sister of William and aunt of John, this famous woman astronomer worked for 50 years with her brother. She discovered eight comets and a number of clusters and nebulae. All three members of this famous family are commemorated on the moon (see Plates XI and XIII). Note the ridge running from this small crater southwest toward Lambert.

Lambert. This crater stands in a rather isolated position on Mare Imbrium.



Its central mountain has a crater-like form at this illumination.

Leverrier. Named for the discoverer of Neptune, this crater and the slightly larger Helicon to the east of it make a striking pair on Mare Imbrium.

Maupertuis. See Condamine, above.

Oenopides. One of the Greek astronomers and philosophers in this part of the moon, named by Riccioli. He is believed to have discovered the inclination of the sun's path to the celestial equator. He was born about 500 B.C.

Pythagoras. This Greek philosopher founded a school of philosophy and science in southern Italy. He is considered the first to maintain that the earth was spherical, at the center of a spherical universe which daily rotated around it. His name is given to one of the most fundamental theorems of geometry, with the origin of which he is usually credited.

Schroeter's Valley. While the formation called Schroeter by Gruithuisen appeared on Plates XI and XII, here is the interesting Schroeter's Valley, so designated by Pickering in honor of the 18th-century German observer who first discovered rills, or clefts, on the moon.

Sinus Iridum. One of the finest regions on the moon, Rainbow Bay was named by Riccioli, as was **Sinus Roris,** the Bay of Dew. Between the two headlands, Pr. Heraclides and Pr. Laplace, Goodacre gives the distance as 135 miles, and states that the bordering mountains rise in places from 15,000 to 20,000 feet above the plain.

CORRECTION — A LETTER

Sir:

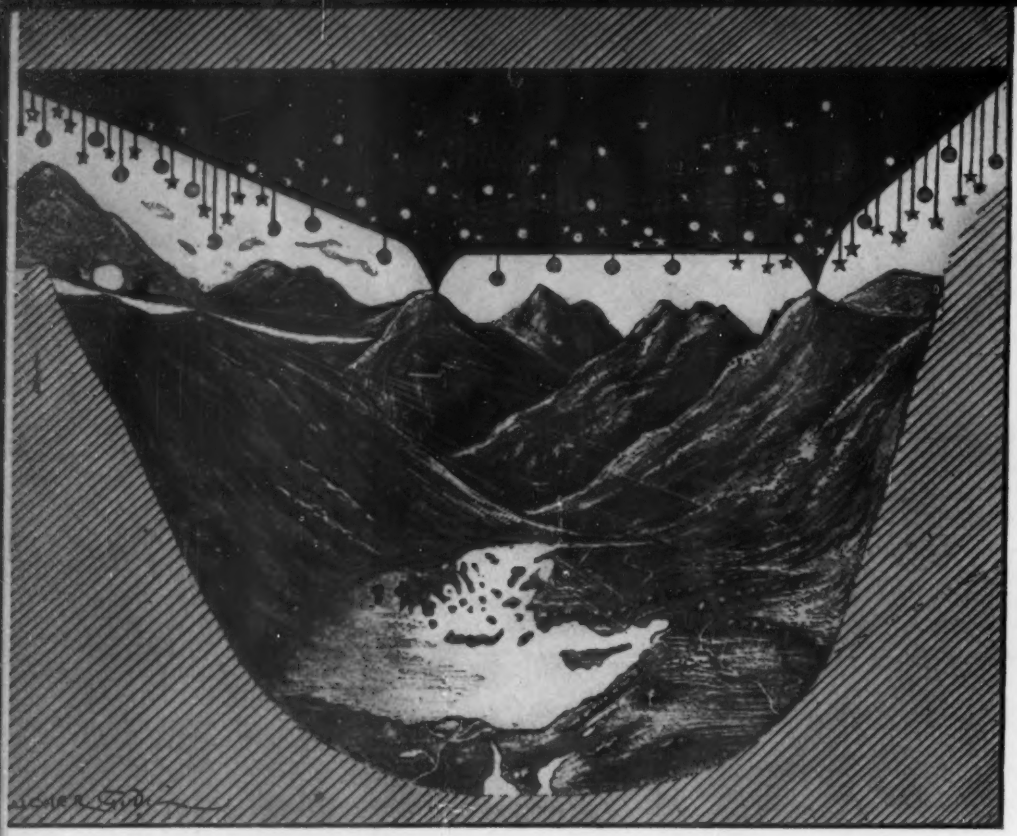
In the May issue I saw in the article In Focus the short notice about Max Wolf, of Heidelberg. There is mentioned that he discovered the stars of **O** type, known as Wolf-Rayet stars. I want to say that the Wolf-Rayet stars were discovered in 1867 by Charles Joseph Etienne Wolf (born 1827) and Rayet, both of the Paris Observatory.

HERBERT LUFT
New York, N. Y.

Max Wolf was born in 1862. Neither of these is to be confused with Rudolph Wolf, of Zurich (1816-1893), who introduced the system of sunspot numbers.—ED.

Astronomy fro

BY



The stars hung like lamps through the ceiling in this early Egyptian concept of the universe, and were lit each evening by the gods. The sun-god traveled in his river chariot along the celestial river each day (upper left).

IN ALL AGES, the heavens have attracted attention in every land of the earth. More or less familiarity with at least the most readily noticeable aspects and phenomena of the skies, and some ideas about their interpretation (even if only mythological) are found among all peoples; and early in the development of every great civilization, the heavens came to be systematically observed, and celestial phenomena recorded and specifically studied. In some cases, astronomy did not develop beyond a comparatively primitive empirical knowledge of the more conspicuous phenomena; but among some of the civilizations of antiquity, astronomical learning reached a highly advanced stage.

Civilization and culture may arise in separate geographical regions independently, and sometimes remain largely or wholly isolated and indigenous in a particular country during a long period of successive rise and decline. In most cases, however, contacts between different peoples lead sooner or later to more-or-less widespread exchanges of ideas and mutual influences on thought. In this way a steadily accumulating heritage of learning from many different sources may develop and be transmitted uninterruptedly from one civilization to another over a long period of history, meanwhile undergoing continual amplification, modification, and extension.

From the viewpoint of an interest primarily in astronomy itself, rather than in history as such, it is the antecedent history of our own learning that is of principal importance. In particular, the development of astronomy which originated in the nearer Orient, especially in Babylonia, among the civilizations that began to emerge there before 3000 B.C., was the beginning of a prolonged evolution which has extended essentially unbroken, through the successive civilizations of ancient Greece, Islam, and Renaissance Europe, into modern times, and has directly led to astronomy as now established in modern western civilization.

Other native developments that progressed beyond the primitive stage either remained completely isolated — for instance, the Mayan astronomy — or else exerted comparatively little influence outside their regions of origin. In China and India, for example, astronomy was cultivated beginning in very remote times, and in each of these countries a system with distinctive native characteristics came into existence; but until a comparatively late period in both regions it was mostly independent of learning to the westward, and remained rather primitive. Chinese astronomy was dominated after the fourth century A.D. by influences from the West, and was almost wholly replaced by western astronomy in the 17th century, without ever having developed very far or having exerted significant influence on western thought. In India, where a fairly advanced Hindu astronomy had developed by the fifth or sixth century A.D. (perhaps partly under Greek influence), progress ceased about the 12th century; and except indirectly through limited contributions to Moslem astronomy, it had no influence on the evolution of modern western astronomy.

In Babylonia, centuries of continued observation of the heavens led to an accumulation of data upon which the later Babylonians founded an elaborate and remarkable system of astronomical learning. The Babylonian astronomy, which reached its most advanced stage in the third and second centuries B.C., together with less important contributions from ancient Egypt, formed an essential part of the basis of ancient Greek astronomy, which culminated in the second century A.D. with the great work of Ptolemy. From Greek astronomy as left by Ptolemy, modern astronomy has been directly derived by progressive revisions and extensions among later civilizations.

The Greek learning became established throughout most of the civilized world during the Roman period, and was actively perpetuated in the East by the Moslems during the Dark Ages in the West. This ancient astronomy, essentially as left by Ptolemy but with some Hindu ideas integrated, was transmitted by the Moslems to western Europe during the Revival of Learning; and with the Renaissance, the revival of astronomy in western Europe led to a transformation of ancient astronomy into modern form, beginning during the 16th and 17th centuries with the successive revisions by Copernicus and Kepler. Copernicus transferred the center of the planetary system from the earth to the sun, but otherwise followed Ptolemy with great fidelity both in the planetary theory (where he retained the Ptolemaic mechanism of eccentrics and epicycles) and in the other parts of astronomy. Kepler, on the basis of Tycho Brahe's observations, modified the Copernican eccentrics to ellipses, and empirically formulated the laws governing the motions of the planets in these ellipses. In this transition period, the foundation was laid for the Newtonian theory and the development of modern gravitational astronomy. Meanwhile, the invention of the telescope had initiated physical astronomy, which eventually led to the extensions to sidereal astronomy and astrophysics that dominate the present period.

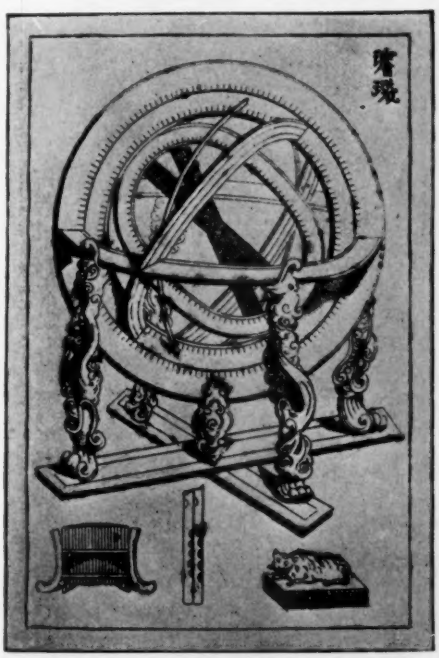
Throughout its course, this long historical development was a continuous progressive revision and extension of the accumulated learning from the past — it was not a discontinuous succession of mutually independent systems of thought, each discarded in turn as a successor abruptly appeared. Each successive revision was explicitly derived from previous developments by means of a

ro the Historical Point of View

BY EDGAR W. WOOLARD

modification or improvement in only particular details. A familiarity with this progressive evolution of astronomy, from its simple beginnings in remote antiquity to its present highly developed and complex form, adds greatly both to the interest of astronomy and to the understanding and appreciation of the subject in its present state. The beginnings of a science are always simple. The most readily noticed phenomena attract attention, and systematic observation of them leads to their co-ordination in an immediate manner by means of very natural concepts and methods; but continued study leads to successive amplifications and modifications which, although each is in itself comparatively small and natural, eventually result in a complex system of advanced concepts, intricate principles, and refined procedures so far removed from their origins, and the cumulative result of so long an evolution, that they may be far from obvious. The subject can then hardly be properly known without knowing how it came into existence. An indication of how the ideas, principles, and results were actually established historically leads to an appreciative insight and comprehension that no mere categorical presentation in systematic logical form can alone convey.

A study of modern astronomy almost inevitably leads to a desire to know how and when and by whom its advanced ideas and complex principles were worked out, and what methods were used to accomplish astronomical observations and calculations before modern refined instruments and highly developed theories were available. An adequate and satisfying answer to these questions can be obtained only from the original writings produced at successive periods throughout past history by the astronomers who made the significant advances and recorded their work and the knowledge of their times in authoritative treatises. The more noteworthy extant writings from ancient times to the 19th century that are of greatest interest to the general reader, and that have been of the most significance and influence in the historical evolution of the now established foundations of astronomy, have been described, and the part of each in the logical development of astronomy briefly discussed, in a previous paper by the writer.*



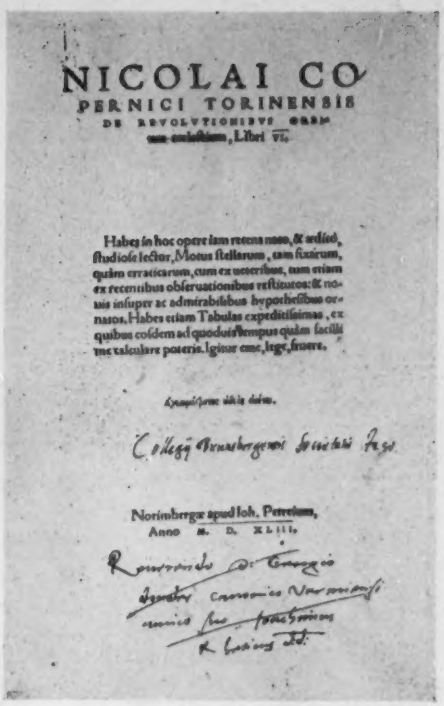
This Chinese armillary sphere, attributed (uncertainly) to the 23rd century B. C., illustrates the advanced state of astronomy in the Orient at an early date. It has four movable circles inside the fixed horizon and vertical circles. From M. G. Pauthier's "Chine."

Supplementing the study of modern textbooks and general histories by reading the actual original accounts of the important past work from which our accumulated knowledge has come is an effective aid to the fullest understanding of this present knowledge, and is a source of inestimable satisfaction and enjoyment. The frequent references in modern writings to Ptolemy's great *Almagest,* or to the epoch-making book by Copernicus, or to Newton's monumental *Principia,* can hardly help but stimulate a desire to see these historic books themselves; and immeasurable pleasure may be found in reading Tycho Brahe's own description of his planetary theory, or Kepler's account of how he worked out his three laws of planetary motion, or the explanations by the ancient Greeks themselves of how they measured the size of the earth. Anyone may have all the greatest astronomers of history for his personal teachers if he will let them speak to him from the pages of their writings. Moreover, in this way the reader obtains a convincing realization of the continuity of the historical development, and a proper appreciation of the acumen possessed by our predecessors, even in ancient times, and of the intrinsic merit of their learning and accomplishments.

To profit from a study of these original writings, however, requires a knowledge of the elements of modern astronomy and of its general historical development, and a background of social and political history of the ancient and medieval civilizations; only in this way may these writings be intelligently followed and properly appraised. No satisfactory comprehensive general history covering the whole development of astronomy is now available; in particular, the important pre-Hellenic learning in Babylonia and Egypt is inadequately treated in most of the existing histories, largely because comparatively little was known about it until recent years. The nearest approach to an adequate general history is E. Zinner, *Geschichte der Sternkunde,* published in Berlin in 1931, but this book has serious shortcomings. Arthur Berry's *Short History of Astronomy,* which appeared in London in 1898, is an unusually excellent work, but is totally lacking in any discussion of either the period preceding the Greeks or, of course, the far-reaching discoveries of the 20th century, and is now a scarce book.

Other recent general histories cover only limited periods: R. L. Waterfield, *A Hundred Years of Astronomy* (London, 1938), and Agnes M. Clerke, *Popular History of Astronomy during the Nineteenth Century* (London, 1902); the older histories by Delambre and others are now of value chiefly as sources for particular periods. The great work by George Sarton, *Introduction to the History of Science,* Carn. Inst. Wash. Publ. No. 376, Baltimore

(Continued on page 18)


NICOLAI CO
PERNICI TORINENSIS
DE REVOLVTIONIBVS ORBI
Libri VI.

Habes in hoc opere iam recens natum, & ædited, studiose lector, Motus stellarum, tam fixarum, quàm erraticarum, cum ex ueteribus, tum etiam ex recentibus obseruationibus restitutos: & nouis insuper ac admirabilibus hypothesibus ornatos. Habes etiam Tabulas expeditissimas, ex quibus eosdem ad quoduis tempus quàm facillime calculare poteris. Igitur eme, lege, fruere.

Norimbergæ apud Ioh. Petreium,
Anno M. D. XLIII.

The title page of the first edition of Copernicus' "De Revolutionibus." Courtesy, the Kosciuszko Foundation.

*Edgar W. Woolard, Great Astronomical Treatises of the Past, *Jour. Wash. Acad. Sci.*, 32, 189-216, 1942. For the period since the invention of printing, see also Harlow Shapley and Helen E. Howarth, *A Source Book in Astronomy*, McGraw-Hill, New York, 1929.

BOOKS AND THE SKY

THE EARTH AND THE STARS

C. G. Abbot. D. Van Nostrand Co., Inc., New York, 1946. 288 pages. $3.75.

HEREWITH Dr. Abbot, genial and well-known investigator of the devious relationships between the earth and its controlling star, presents a refurbished edition of a book for non-technical readers which first appeared two decades ago. In Part I, "The Mighty Universe," are chapters which lead the reader to a lonely hilltop of observation, register "the great enigma of Astronomy" as to the existence elsewhere of thoughtful life, introduce the starry skies by description and maps, and present in 60-odd pages a general view of the universe. Distracting details are postponed to Part II, "Interesting Astronomically Related Subjects."

The greatest proportion of new subject matter in the book is in two sections on the "Variability of the Sun" and "Weather Effects of Solar Changes." How the solar constant behaves in relation to the number of spots, how the magnetic 22¼-year period emerges as basic to numerous long solar periodicities detected by the author, and how terrestrial temperatures respond systematically to rising and falling solar radiation, as observed in the last two decades: all these matters are discussed with the help of frequent diagrams.

The reader's pleasure is greatly enhanced by the easy style of the author, his apt similes, and his knack of making remote experiments and experimenters come alive. The Greenland meteorite now in the Hayden Planetarium in New York is like "a wild animal of the jungle caged in a zoological garden." The Cepheids, "like the heart," are supposed to be pulsating. C. A. Young's gem, "The sun is a private in the host of heaven," is perpetuated here by being twice quoted. In similar vein, the sun is commended for obeying the spirit of Robinson Crusoe's father's advice "to stick to the middle class as the happiest." The total solar eclipse, whose loveliness is enhanced by its rarity, finds a parallel in the night-blooming cereus of the tropics. We have the labor unionists on Jupiter adjusting their demands for a three-hour working day, and the skillful baker on Mercury trying to keep his bread and biscuits from burning under the open sun. Not just any mountain, but Mt. Schehallion in Scotland aids in the determination of the earth's mass. Halley appears as Newton's friend and James Watson has a "fatherly interest" in the asteroids. As a result of Kirchhoff's work, "Astronomers no longer need wish that some angel would bring down star samples for analysis."

The reference value of a book may be rated by certain convenience tests, such as: Are good diagrams and plates numerous and are they inventoried? Is the index adequate? Are graphs labeled to show the meaning of co-ordinates, and are diagrams in general provided with necessary legends? This book stands high on all tests but the last. Cepheid variation, internal conditions in the sun, features of the eclipsing binary, and several of the solar diagrams merit more careful explanation. A series of appendices contains useful technical information, including a comprehensive glossary. Excellent photographs of Hale, Eddington, Einstein, and W. S. Adams appear along with earlier astronomers. A regrettable blemish lies in the fact that all references in the text to plates after Plate IX are in error by two units; for example, for "Plate XX" read Plate XVIII.

A number of inaccuracies, partly anachronisms, have been noted. Mizar is itself quadruple rather than triple. The extension of the BD catalogue to the south pole was carried out at Cordoba Observatory, but not by Gould. Since the discovery of the Grootfontein meteorite in South Africa, Peary's Greenland object is not the largest known. Not "nearly a thousand" asteroids but more nearly two thousand have already been discovered. Amor, Apollo, Adonis, and Hermes, though not as useful as Eros, have nevertheless come

closer to the earth. Wildt's intriguing earlier (1940) suggestion that formaldehyde might be the effective constituent of the opaque white clouds on Venus was retracted with regret about two years later. The sun's distance obtained from the latest and most thorough triangulation on Eros is 93,004,000 miles. "Some ionized state of some common element" as the source of the chief coronal green line may now be written "Fe XIV," following general acceptance of Edlén's identification in 1941. The enumeration of objects lying within a million or less light-years of the sun, forming in some sense the local cluster of galaxies, needs the addition not only of the well-known spiral in Triangulum but also of the two elliptical galaxies in Cassiopeia, eight degrees north of the Andromeda triplet, reported by Baade.

The reviewer may be permitted a few comments on some puzzling or possibly misleading statements. The bright stars of Orion can hardly be said to form a square. Cassiopeia's feet seem far nearer to Capella than to Arcturus. Omitted from the elements of an orbit is the distance from node to perihelion. The bands in M-type spectra are attributable not to cyanogen but to titanium oxide. "Ionized electrons" is a bit confusing as a term for free or recombining electrons. Solar spectrum lines from the receding west limb of the sun are displaced to the red rather than to the violet. In view of the absence of conspicuous displays both in 1899 and 1933, it seems misleading to say that the next great November shower of meteors is due in 1966. The gegenschein would best be sought near meridian passage at midnight rather than within two hours of sunset or sunrise as stated.

The book appears in attractive format, large print, and amply fulfills the author's hope that it will be helpful to those who wish to acquire by easy reading a general survey of the universe in which they dwell.

ALICE H. FARNSWORTH
Mount Holyoke College

NEW ENGLAND FIELD TRIP

(Continued from page 6)

the recording sheet on which an inked needle traced earth vibrations (as well as those made by a technician walking on the foundation below).

From the attractive Agassiz Cottage, which provides home and recreation facilities for working and visiting astronomers, a welcome picnic supper prepared by our hosts swiftly appeared, and was dispatched even more swiftly. An impromptu softball game, in which Barbara and Tony Federer starred, and a visit to a lofty firetower nearby occupied the twilight hours. Even before dusk, some enthusiasts were examining the rings and satellites of Saturn with the 6-inch Clark refractor (which only the vigilance of the Oak Ridge staff saved from abduction by bus to New York). The evening came to a highly satisfactory conclusion with the privilege of "interfering" with Dr. Bok and his assistant at his galactic photographic activities with the famous 24-inch Jewett Schmidt telescope.

A continuance of azure skies on Sunday morning graced a visit to Whitin Observatory at Wellesley College. There Dr. and Mrs. John C. Duncan and several of the vivacious students welcomed the group with telescopic views of a gibbous Venus and projected sunspots. Beneath a library in which pleasure and learning coalesced, Dr. Duncan demonstrated with the spectrohelioscope the observation of solar prominences and spectra. Browsing in the reference room, picture-taking, and strolling on the idyllic Wellesley campus ended a memorable visit.

From the celestial to the terrestrial, which is the sad lot of all astronomers, the elated and pleasantly tired amateurs returned Sunday evening through holiday traffic to their headquarters, the Hayden Planetarium. All were grateful for the astronomically and meteorologically perfect outing, and thankful for the co-operation of the many professional scientists responsible for much of the success of this very special event. The remainder of the well-deserved credit must go to the AAA's Special Events committee and its acting chairman, Marion L. Louis.

Planetarium Notes

ADLER PLANETARIUM

900 E. Achsah Bond Drive, Chicago 5, Ill. Wabash 1428

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Tuesdays and Fridays, 8 p.m.; Sundays, 2:30 and 3:30 p.m.

STAFF: *Director,* Wagner Schlesinger. *Other lecturer:* Harry S. Everett.

July: REASONS FOR THE SEASONS. Changes in the sun's daily path across the heavens resulting from the earth's motion around the sun are shown to be the causes of the seasons.

August: AURORAS AND RAINBOWS.

BUHL PLANETARIUM

Federal and West Ohio Sts., Pittsburgh 12, Pa. Fairfax 4300

SCHEDULE: Mondays through Saturdays, 3 and 8:30 p.m.; Sundays and holidays, 3, 4, and 8:30 p.m.

STAFF: *Director,* Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

July: BY ROCKET TO THE MOON. An imaginary but eventful journey in a space ship of the future to view the moon's weird scenery, and with a safe return guaranteed.

August: BY ROCKET TO THE MOON.

FELS PLANETARIUM

20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Rittenhouse 3050

SCHEDULE: 3 and 8:30 p.m. daily except Mondays; also 2 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director,* Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

July: STARS OF A SUMMER NIGHT. The constellations offer to the beginner an opportunity to make summer evenings out of doors more enjoyable. The legendary characters will be pictured among the planetarium stars while their stories are told.

August: HEAVENS ABOVE!

GRIFFITH PLANETARIUM

P. O. Box 9787, Los Feliz Station, Los Angeles 27, Cal., Olympia 1191

SCHEDULE: Wednesday and Thursday at 8:30 p.m. Friday, Saturday, and Sunday at 3 and 8:30 p.m. Extra show on Sunday at 4:15 p.m.

STAFF: *Director,* Dinsmore Alter. *Other lecturers:* C. H. Cleminshaw, George W. Bunton.

July: THE SUMMER STARS. The outlines of the mythological figures are projected in the heavens as an aid in learning the principal stars and constellations of the summer sky.

August: THE MOON AND THE CALENDAR.

HAYDEN PLANETARIUM

81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.

STAFF: *Honorary Curator,* Clyde Fisher. *Chairman and Curator,* Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale, Edward H. Preston.

July: SKY PANORAMA. What are the brightest stars? This month these and the constellations to which they belong will parade across the planetarium sky in all their splendor.

August: DRAMA OF THE TELESCOPE.

GLEANINGS FOR A. T. M.s

GLEANINGS FROM THE MAILBAG

Ludwig Pope had his wartime telescope attached to the porch rail for support. Note the extension on the tube which was not originally long enough.

CONSTANT STRIVING for improvement is characteristic of the good amateur telescope maker. Ludwig Pope, of New York City, sends us the story of the development of his 6-inch reflector from its first form as a wartime product four years ago to its present state, considered satisfactory by its owner.

"I was not satisfied with the first arrangement of my telescope," Mr. Pope writes, "which was constructed during the war when the shortage of materials made things difficult. The only piece of tubing I could obtain was part of an exhaust pipe of a toolroom grinder, and this was not long enough. Therefore, I built an extension to get support for the diagonal and the eyepiece holder.

"But the mounting was especially unsatisfactory, and the telescope had to be attached to the porch railing for rigidity until I replaced the mounting with a wooden stand which is shown in the second picture. With this mounting and the

The finally improved telescope, with the circles, and the offset of the declination axis support to enable the instrument to clear the supporting legs when pointed to the zenith. The 30-pound weight hanging in the center of the base gives added rigidity.

EDITED BY EARLE B. BROWN

original equatorial head the zenith was not available because the stand obstructed the lower end of the tube, so I added an extension to the declination axis support to permit a more complete swing.

"The new mounting has engraved scales and micrometer adjustments, and has proven very satisfactory in its present form. The adjustment screws have 40 threads to the inch. The 30-pound weight is added for rigidity when observing from the roof of my apartment house."

Mr. Pope sent several other pictures of his instrument and one of his 4½-year-old son, Roland, who is already interested in astronomy, but space does not permit publication of these other pictures.

Sir:

I was much interested in the account in the May issue of the Gregorian reflector made by Short of England in 1750, as I also have a small Gregorian reflector made by him.

This instrument was picked up second-hand in London about 1900 and used by my father merely as an ornament in his library. On his death in 1910 it was sent to me, and I have used it at the beach cottage for many seasons. Its loss of light makes it unadaptable for celestial use, but that loss makes it just right for use at the beach where the light is strong. The power is about 30, diameter about 2½ inches. The workmanship and finish are beautiful and undamaged. I think that it was made about 1750 to 1760.

If any of your readers pay a visit to Mount Vernon, Va., they will see in the museum there an exact duplicate of this instrument owned by George Washington, the only difference being that the body is brass while my instrument is leather covered.

WALTER E. INGLIS
Bridgeport, Conn.

Sir:

In the May number of your **Sky and Telescope** I notice three items:

(1) Old Gregorians similar to that on the front cover are not uncommon in England. I have three, clean and in good order and of very fair performance; makers unknown.

As they get very badly out of balance for high altitudes, I commonly grip a weighty screw wrench on the lip of the tube, as a way of avoiding a black eye!

(2) The large telescope ascribed to Ramsden and answering to the figure and description on pages 16-18 is set up in the Science Museum, South Kensington.

(3) On page 12, Professor Barnard's discovery of Nova Aquilae 1918, the night of June 8th, together with the same observation from an American troopship, is mentioned. India is some distance east, and it is therefore earlier on the same date that Noel Bower communicated his discovery of the same nova to the observatory at Kodaikanal.

W. H. WHITE, F.R.A.S.

There were a number of independent discoverers of the spectacular Nova Aquilae. Bower is credited with first observing its rise to maximum.—ED.

ASTRONOMY FROM THE HISTORICAL POINT OF VIEW

(Continued from page 13)

1927-, extends as yet only through the 14th century, but is of especial value both as a source history and for the general summaries of scientific and cultural progress among different nations that it includes. A valuable review of ancient astronomy has been published by O. Neugebauer, "The History of Ancient Astronomy; Problems and Methods," appearing in the *Journal of Near Eastern Studies, 4*, 1-38, 1945, and in revised form in the *Publications* of the Astronomical Society of the Pacific in February and April, 1946.

On special topics, a few very excellent histories have been published: J. L. E. Dreyer, *History of the Planetary Systems* (Cambridge, 1906), covers the development of theoretical astronomy from Thales to Kepler; and the early part of the period of gravitational astronomy is treated in Robert Grant, *History of Physical Astronomy* (London, 1852), which also includes some account of the evolution of astronomical instruments and methods of measurement. Early Greek astronomy to about 250 B.C. is covered in detail by Sir Thomas Heath, *Aristarchus of Samos* (Oxford, 1913). All these books are unfortunately now rare. Further special histories are also needed, particularly, (1) a systematic account of Babylonian and Egyptian astronomy, based on a critical study of all the original material that has been made available by Assyriologists and Egyptologists; (2) a detailed history of the instruments and methods used for astronomical observations and for the measurement of astronomical quantities, from the earliest times to the present; and (3) a comprehensive treatment of the methods for the construction of theories and tables of the celestial motions, and procedures for predicting phenomena and calculating ephemerides, successively in use throughout the history of astronomy.

Aside from the increased technical understanding which may be derived from the historical development of astronomical principles, methods, and theories, and the added appreciation of the significance of the work of past centuries for modern astronomy, the enjoyment and inspiration that may be obtained from the night sky are greatly enhanced by this direct contact with those who have watched this same sky from many lands through many ages, and who have effectively added to its beauty and fascination by increasing our comprehension of its impressive phenomena. The association of celestial phenomena with the ideas, traditions and legends of immemorial ages is an important and worthwhile element in the romance and charm of the heavens.

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FOR SALE: Four complete reflecting telescopes. 54" f. l. aluminized parabolic mirrors, heavy equatorial mounts. Price $90.00 each. Inquiries, W. J. Kennedy III, 1038 Audubon, Grosse Pointe 30, Mich.

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PHOTOGRAPHS, observatories in natural color, Mt. Palomar, McDonald, Yerkes, Lowell, Mt. Wilson, also 100" telescope. Meteor Crater (distant), Meteor Crater from rim. Beautiful genuine natural color photos, 3" x 4⅜", mounted. $1.25 each, five or more $1.10 each. Satisfaction guaranteed. Emil Klein, 7234 Algon Ave., Philadelphia 11, Pa.

TRADE: One Hammerlund HQ-129-A communications receiver with speaker and AAF earphones for a 12" more-or-less parabolic aluminized telescope mirror. With cell, preferred. Sam K. Swope, Rockville, Ind.

WANTED: Refractor 5" to 9", must be standard make, excellent objective. Vincent Flynn, 555 Herkimer, Pasadena, Calif.

FOR SALE: 10" x 1¾" pyrex blank; 10" x 1" tool, both $13.00. 6" plate mirror, 49" f.l., figured by professional, aluminized; 1¼" prism, both $22.00. Edgar Spearman, 1735 Pear St., Dallas 15, Tex.

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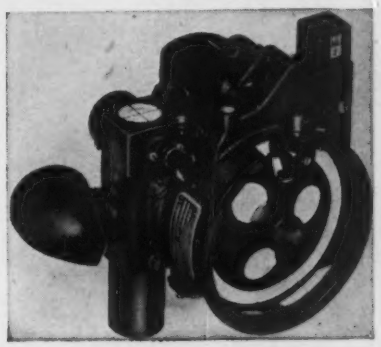

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OBSERVER'S PAGE

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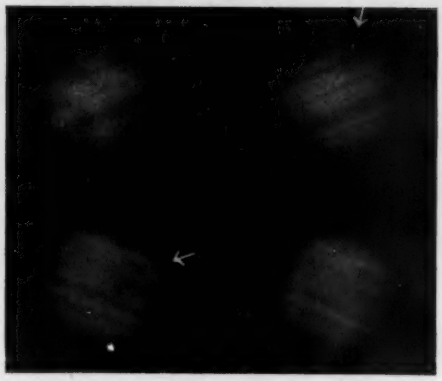
THE MOTIONS OF JUPITER'S RED SPOT

THE GREAT RED SPOT on Jupiter has been in existence longer than a century. It first attracted wide attention in 1878. Variable in visibility, it was conspicuous in April, 1946.

The red spot is located in the south tropical zone in about 25 degrees south latitude. The mean rotation period of this zone is $9^h\ 55^m\ 40^s.632$. The rotation period of the red spot seems to present a cycle of change having a duration of perhaps 56 years. In 1890-94 the rotation period was $9^h\ 55^m\ 41^s.590$. The motion became increasingly rapid until the period of rotation was about 5.065 seconds less during the interval 1912-24, the mean being $9^h\ 55^m\ 36^s.525$. From 1928 to 1932, it was $9^h\ 55^m\ 38^s.442$.

Since 1938 the rotation period has continued to increase, remaining constant, however, from 1941 to 1943. From that time, the spot has been steadily gaining in longitude, and the interval from March 27, 1945, to April 21, 1946, showed a change from longitude 196.2 degrees to 218.5 degrees (System II), furnishing a rotation period of $9^h\ 55^m\ 42^s.959$. This may suggest a cycle having a period of more than half a century.

Observations of Jupiter have been infrequent here in 1947. The red spot has not been seen, but Walter H. Haas reports, in the June issue of the **Strolling Astronomer,** that the white oval in the south tropical zone which usually marks the location of the red spot when the spot itself is not visible was central in longitude 222 degrees during the first 25 days in May, 1947. This indicates that the motion in increasing longitude is continuing. Longitudes are computed from predicted transits of the zero meridian according to two systems. System I, having a rotation period of $9^h\ 50^m\ 30^s.004$, is confined to the equatorial regions, while System II, comprising the rest of the planet, has a rotation period of $9^h\ 55^m\ 40^s.632$. Since the red spot is located in the south tropical zone, its longitudes are those of System II.



Jupiter in April, 1946 (above) and August, 1938 (below) with arrows pointing to the great red spot. Photos by Latimer J. Wilson.

A rival dark red marking appeared in the south tropical zone in about 1901, and has been intermittently visible since. Its motion is usually rapid in decreasing longitude, more rapid than the normal motion of the red spot. Curiously, it overtakes and passes the red spot, producing a marked change in the motion of the latter. The south tropical disturbance is now visible, the preceding part of the dark wedge-shaped area having a longitude of 308 degrees on June 1, 1947, at $4^h\ 43^m$ Universal time. Observation was made with a 6-inch reflector, 128x, seeing conditions good. A large part of the south tropical zone is dusky red at present, according to the writer's opinion.

Predicted longitudes at zero hours, Universal time, for System I and System II are published on pages 416 and 417 of the **American Ephemeris.** Since 36.580 degrees per hour represents the rotation of System I, with 36.262 degrees per hour for System II, the central meridian according to each system can be easily computed for any particular time of observation. When seen well, Jupiter rewards the observer with more rapidly changing detail than any other telescopic object except the sun.

LATIMER J. WILSON
1606 Woodland St.
Nashville 6, Tenn.

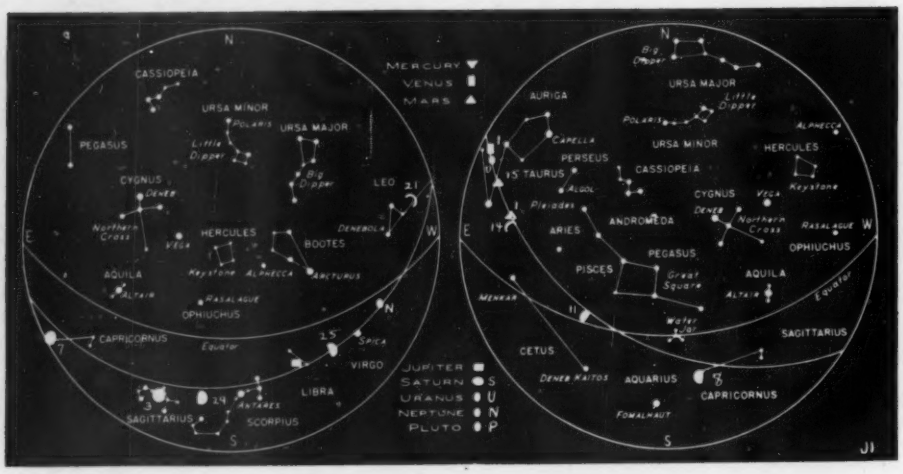
REFERENCES

Monthly Notices, R. A. S., LI, 9, 1890, E. E. Barnard.

Astronomy and Astrophysics, No. 129, November, 1894, E. E. Barnard.

Popular Astronomy, XXXII, 8, October, 1924, L. J. Wilson.

THE MOON AND PLANETS IN THE EVENING AND MORNING SKIES



In mid-northern latitudes, the sky appears as at the right at 3:30 a.m. local time on the 7th of the month, and at 2:30 a.m. on the 23rd. At the left is the sky for 9:30 p.m. on the 7th and 8:30 p.m. on the 23rd. The moon is shown for certain dates by symbols which give roughly its phase. Each planet has a special symbol, and is located for the middle of the month, unless otherwise marked. The sun is not shown, although at times it may be above the indicated horizon. Only the brightest stars are included, and the more conspicuous constellations.

Mercury comes to inferior conjunction on July 14th, and hence is not visible most of the month. However, it may be seen the last few days of the month, rising before the sun.

Venus remains a morning star, rising about an hour before the sun. It may be seen only in twilight, and after this month will disappear into the glare of the sun, to emerge in the evening sky this October.

Earth on July 5th reaches aphelion, or greatest distance from the sun.

Mars, a 1st-magnitude object, may easily be located in Taurus in the morning hours. It rises from 2½ to 3½ hours ahead of the sun. On the 15th Mars is 5° north of Aldebaran, the planet somewhat fainter. On the night of the 15-16th the moon will be just to the north of Mars.

Jupiter may be seen close to the meridian in the early evening. It is the brightest object in the sky at present, at magnitude −1.8. Its setting time is about midnight. The planet remains almost stationary all month in central Libra, though eastward motion is resumed on July 16th. On the night of the 25-26th, the moon and Jupiter will be in close conjunction.

Saturn, in close proximity to the sun in the evening sky, will not be visible most of the month.

Uranus will rise three hours before the sun at the end of July. It is about 2° north of Zeta Tauri.

Neptune sets only three hours after the sun. Its position on the 15th is $12^h\ 32^m.5$, −1° 52′, about 1½° southwest of Gamma Virginis.

EDWARD ORAVEC

GREENWICH CIVIL TIME (GCT)

TIMES used on the Observer's Page are Greenwich civil or universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the GCT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.

OCCULTATION PREDICTIONS

10-11 **33 Ceti** 6.2, 1:07.8 +2-09.8, 22, Em: **A** 7:14.5 −0.1 +2.8 183; **B** 7:22.0 −0.2 +2.6 193; **C** 7:03.7 0.0 +3.0 183; **D** 7:16.1 −0.2 +2.5 197; **E** 7:04.8 −0.1 +2.4 201; **F** 6:36.9 +0.1 +3.7 180.

28-29 **136 G Ophiuchi** 6.3, 17:23.6 −25-53.9, 11, Im: **A** 1:53.5 −2.1 −0.3 107; **B** 1:50.8 −2.0 −0.2 104; **C** 1:45.2 −2.1 −0.4 115; **D** 1:39.8 −1.9 0.0 110; **E** 1:21.0 −1.3 −0.2 129; **F** 1:27.5 +0.6 −3.3 174.

29-30 **66 B Sagittarii** 4.7, 18:14.7 −27-03.8, 12, Im: **A** 0:41.4 −1.3 +0.2 124; **C** 0:36.2 −0.9 −0.3 137; **E** 0:30.6 +0.4 −1.3 160. Em: **A** 2:01.4 −2.3 +0.6 253; **C** 1:47.0 −2.6 +1.3 244; **E** 1:13.1 −2.7 +2.9 225.

For selected occultations (visible at three or more stations in the U. S. and Canada under fairly favorable conditions), these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, GCT, **a** and **b** quantities in minutes, position angle; the same data for each standard station westward.

Longitudes and latitudes of standard stations are:

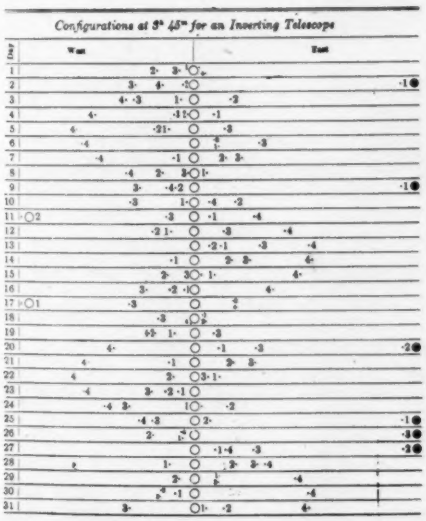
A	+72°.5, +42°.5	**E**	+91°.0, +40°.0
B	+73°.6, +45°.6	**F**	+98°.0, +30°.0
C	+77°.1, +38°.9	**G**	+114°.0, +50°.9
D	+79°.4, +43°.7	**H**	+120°.0, +36°.0
		I	+123°.1, +49°.5

The **a** and **b** quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. **Lo**, lat. **L**) within 200 or 300 miles of a standard station (long. **LoS**, lat. **LS**). Multiply **a** by the difference in longitude (**Lo** — **LoS**), and multiply **b** by the difference in latitude (**L** — **LS**), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Greenwich civil time to your own standard time.

For additional occultations consult the **American Ephemeris and Nautical Almanac** and the **British Nautical Almanac**, from which these predictions are taken. Texas predictions were computed by E. W. Woolard and Paul Herget.

JUPITER'S SATELLITES

Jupiter's four bright moons have the positions shown below for the GCT given. The motion of each satellite is from the dot to the number designating it. Transits of satellites over Jupiter's disk are shown by open circles at the left, and eclipses and occultations by black disks at the right. Reproduced from the **American Ephemeris and Nautical Almanac.**



VARIABLE STAR MAXIMA

July 6, V Cassiopeiae, 7.9, 230759; 7, U Herculis, 7.6, 162119; 17, R Normae, 7.2, 152849; 23, T Centauri, 6.1, 133633; 29, R Serpentis, 6.8, 154615. August 2, S Carinae, 5.7, 100661; 2, RR Sagittarii, 6.6, 194929.

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO, Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

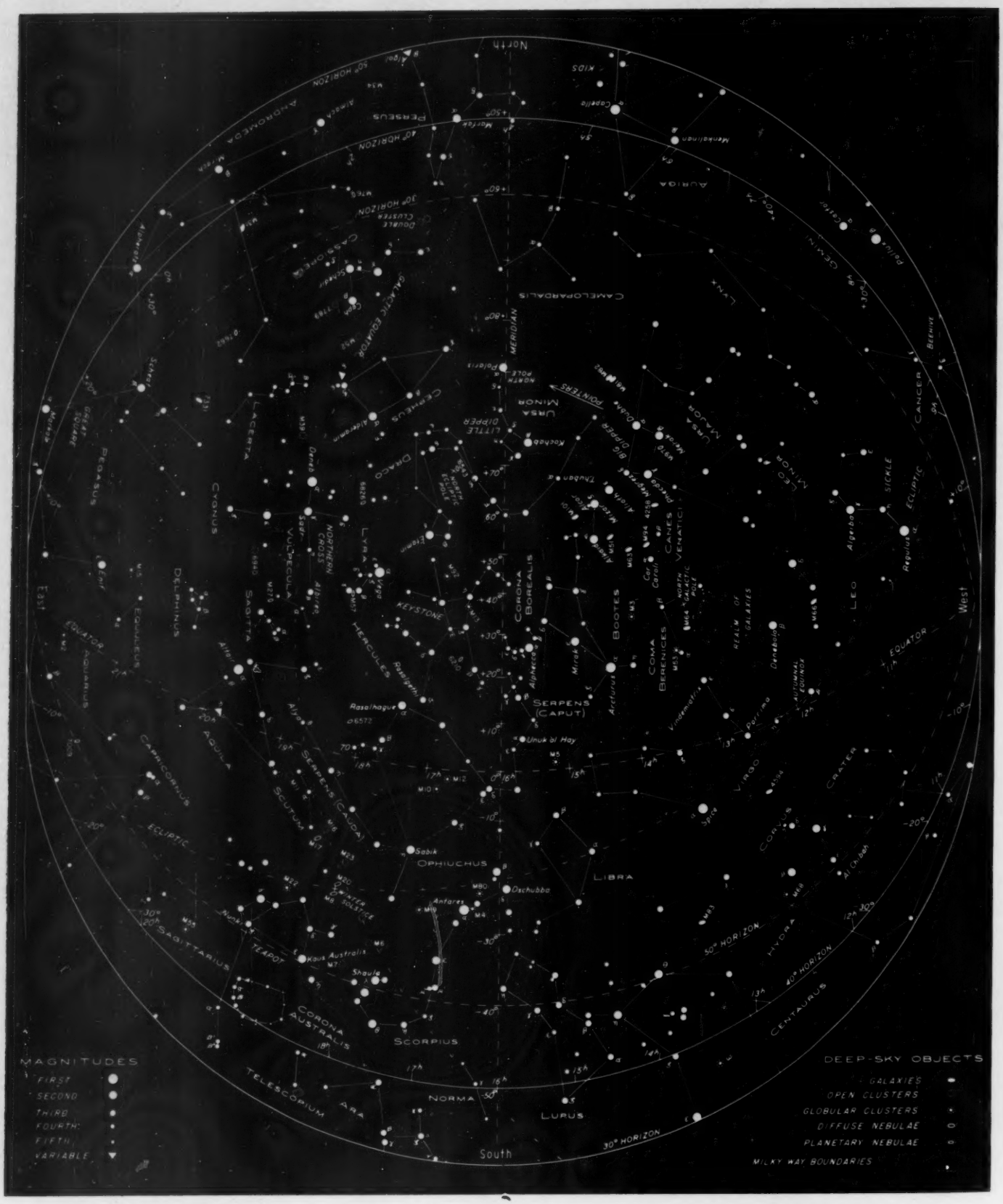
Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

MINIMA OF ALGOL

July 2, 04:05; 5, 00:54; 7, 21:43; 10, 18:31; 13, 15:20; 16, 12:09; 19, 08:57; 22, 05:46; 25, 02:35; 27, 23:23; 30, 20:12. August 2, 17:00.

PHASES OF THE MOON

Full moon	July	3, 10:38
Last quarter	July	11, 10:54
New moon	July	18, 4:15
First quarter	July	24, 22:54
Full moon	August	2, 1:50



DEEP-SKY WONDERS

THE CONSTELLATION Hercules is best known for the magnificent globular cluster M13, but it contains several other desirable objects. Positions are for 1900.

NGC 6058, $16^h\ 01^m$, $+40°\ 58'$, a faint planetary with a 12th-magnitude central star. NGC 6205, $16^h\ 38^m$, $+36°\ 39'$, the great M13 which, however, needs at least a 10-inch to reveal its full beauty.

NGC 6207, $16^h\ 39^m$, $+37°\ 01'$, an Sb spiral, $2'$ x $0.7'$, total magnitude 12.3 and thereby faint. NGC 6210, $16^h\ 40^m$, $+23°\ 59'$, a planetary which looks much like an out-of-focus star; use 100x. NGC 6229, 50^4, $16^h\ 44^m$, $+47°\ 42'$, a globular cluster, described by Smyth and subsequently by Webb as a planetary, rather faint in small instruments. NGC 6341, M92, $17^h\ 14^m$, $+43°\ 15'$, a bright globular cluster which is much neglected, overshadowed as it is by its more famous neighbor.

WALTER SCOTT HOUSTON

STARS FOR JULY

This chart shows the sky as it is seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. When facing north, hold "North" at the bottom, and similarly for other directions. This is a stereographic projection, in which the flattened appearance of the sky itself is closely reproduced, without distortion.

HERE AND THERE WITH AMATEURS

This is not intended as a complete list of societies, but rather to serve as a guide for persons near these centers, and to provide information for transplanted amateurs who may wish to visit other groups. The asterisks denote societies whose members receive *Sky and Telescope* as a privilege of membership. The daggers denote societies which are members of the Amateur Astronomers League.

City	*Organization*	*Date*	*P.M.*	*Season*	*Meeting Place*	*Communicate with*
ANN ARBOR	*ANN ARBOR A.A.A.	.....	.....	.....	.....	Miss E. McLaughlin, 1214 W. Wash., 22885
BADEN, PA.	†*BEAVER CO. A.A.A.	2nd Tue.	8:00	Sept.-June	Private homes	Mrs. R. T. LuCaric, Bx. 463, *Baden* 2365
BATTLE CREEK	B. C. A. A. CLUB	2nd Fri.	8:00	Oct.-June	Battle Creek Museum	Mrs. W. V. Eichenlaub, 47 Everett St.
BOSTON	†*BOND AST. CLUB	1st Thu.	8:15	Oct.-June	Harvard Obs.	Miriam Dickey, Harvard Observatory
"	†*A.T.M.s OF BOSTON	2nd Thu.	8:00	Sept.-June	Harvard Obs.	A. G. Hall, 206 Maplewood St., Watertown
BROOKLYN, N.Y.	ASTR. DEPT., B'KLYN INST.	Rd. Table 3rd Thu.	8:15	Oct.-April	Brooklyn Inst.	William Henry, 154 Nassau St., N. Y. C., *BA.* 7-9473
BUFFALO	*A.T.M.s & OBSERVERS	1st, 3rd Wed.	7:30	Oct.-June	Mus. of Science	J. P. Dow, E. Main St., R. D. 3, E. Aurora
CHATTANOOGA	BARNARD A. S.	2nd Fri.	8:00	Oct.-May	Jones Observatory	C. T. Jones, 302 James Bldg., *CHat.* 7-1936
CHICAGO	†*BURNHAM A. S.	2nd Tue.	8:00	Sept.-June	Chi. Acad. of Sciences	J. M. Showalter, 6200 Kenmore Ave.
"	CHICAGO A. S.	Monthly	8:00	.....	Adler Planetarium	Adler Plan., *Wabash* 1428
CINCINNATI	*CIN. A. A.	2nd Fri.	8:00	Sept.-June	Cincinnati Obs.	T. R. Stoner, RR 8, Cin. 30, *BE* 7937-R
"	†*CIN. A. S.	2nd Wed.	.....	.....	5556 Race View Ave.	A. H. Hasemeier, 2945 Ravogli Ave.
CLEVELAND	CLEVELAND A. S.	Fri.	8:00	Sept.-June	Warner & Swasey Obs.	Virginia Burger, Warner & Swasey Obs.
COLUMBIA, S. C.	NORTH'N CROSS A.S.	Every Mon.	8:15	All year	Melton Observatory	Dr. L. V. Robinson, Univ. of S. C.
COLUMBUS, OHIO		Last Tue.	8:00	All year	McMillin Obs.	J. A. Hynek, Ohio State Univ.
DAYTON	A.T.M.s OF DAYTON	3rd Sat.	Eve.	.....	Private homes	W. C. Braun, New Lebanon
DAYTONA BEACH	D. B. STARGAZERS	Alt. Mon.	8:00	Nov.-June	500 S. Ridgewood Ave.	Rolland E. Stevens, 500 S. Ridgewood
DETROIT	†*DETROIT A. S.	2nd Sun.	3:00	Sept.-June	Wayne U., Rm. 187	E. R. Phelps, Wayne University
"	†*N. W. DETROIT A.S.	1st Tue.	8:00	Sept.-June	Redford High Sch.	John W. Broxholm, 21412 Pickford
DULUTH, MINN.	*DARLING AST. CLUB	1st, 3rd Fri.	8:00	All year	Darling Observatory	Sam M. Cox, 127 N. 10 Ave E., *Hem.* 4827
FT. WORTH	TEX. OBSERVERS	No regular meetings				Oscar E. Monnig, 1010 Morningside Dr.
GADSDEN, ALA.	ALA. A. A.	1st Thu.	7:30	All year	Ala. Power Audit.	Brent L. Harrell, 1176 *W* or 55
GENEVA, ILL.	*FOX VALLEY A. S.	3rd Tue.	8:00	.....	Geneva City Hall	Joseph Zoda, 501 S. 6th, St. Charles
HOUSTON	*HOUSTON A. S.	Last Fri.	7:30	All year	Mus. Nat. Hist. Annex	W. D. Martin, 5624 Dwinnel Dr.
INDIANAPOLIS	†INDIANA A. A.	1st Sun.	2:15	All year	Odeon Hall	E. W. Johnson, 808 Peoples Bank Bldg.
JACKSONVILLE	†*J. A. A. C.	1st, 3rd Mon.	8:00	All year	Private homes	E. L. Rowland, Jr., 442 St. James Bldg.
JOLIET, ILL.	†JOLIET A. S.	Alt. Tue.	8:00	Oct.-May	Jol. Mus. & Art Gall'y	Mrs. Robert L. Price, 403 Second Ave.
KALAMAZOO	†KALAMAZOO A.A.A.	Sat.	8:00	Mar.-Dec.	Private homes	Mrs. G. Negrevski, 2218 Amherst, 31482
KEY WEST, FLA.	†KEY WEST AST. CLUB	1st Wed.	8:00	All year	Private homes	W. M. Whitley, 1307 Div. St., 724-R
LOS ANGELES	L.A.A.S.	2nd Thu.	8:15	.....	2606 W. 8th St.	A. M. Newton, 2606 W. 8th St.
LOUISVILLE, KY.	†L'VILLE A. S.	1st Tue.	8:00	Sept.-May[1]	Univ. of Louisville	B. F. Kubaugh, 621 S. 34th St.
MADISON, WIS.	†MADISON A. S.	2nd Wed.	8:00	All year	Washburn Obs.	Dr. C. M. Huffer, Washburn Obs.
MEMPHIS	A.T.M.s OF MEM.	Meetings suspended				R. E. Wendt, Jr., 2084 Linden Ave.
MIAMI, FLA.	SOUTH'N CROSS A.S.	Every Fri.	7:30	All year	M. B. Lib. Grounds	A. P. Smith, Jr., 426 S.W. 26th Road
MILWAUKEE	†MILW. A. S.	1st Thu.	6:15	Oct.-May[2]	City Club	E. A. Halbach, 2971 S. 52 St.
MOLINE, ILL.	†*POP. AST. CLUB	Wed.[3]	7:30	Feb.-Nov.	Sky Ridge Obs.	Carl H. Gamble, Route 1
NASHVILLE	BARNARD A. S.	2nd Thu.	7:30	All year	Vanderbilt Univ.	E. Keller, 2106 15th Ave. S.
NEW HAVEN	†NEW HAVEN A.A.S.	4th Sat.	8:00	Sept.-June	Yale Obs.	J. J. Neale, 29 Fairmont Ave.
NEW ORLEANS	A.S. OF N. ORLEANS	Last Wed.	8:00	Sept.-May	Cunningham Obs.	Dr. J. Adair Lyon, 1210 Broadway
NEW YORK	*A.A.A.	1st, 3rd Wed.	8:15	Oct.-May	Amer. Mus. Nat. Hist.	G. V. Plachy, Hayden Plan., *EN.* 2-8500
"	JUNIOR AST. CLUB	1st, 3rd Fri.	8:00	Oct.-May	Amer. Mus. Nat. Hist.	J. B. Rothschild, Hayden Plan., *EN.* 2-8500
NORFOLK, VA.	†*A.A.S. OF NORFOLK	2nd, 4th Thu.	8:00	All year	635 W. 29th St.	P. N. Anderson, 635 W. 29th St.
NORWALK, CAL.	EXCELSIOR TEL. CLUB	Thu.	7:00	All year	Excelsior Union H. S.	Geo. F. Joyner, 410 Sproul St.
NORWALK, CONN.	NORWALK AST. SOC.	Last Fri.	8:00	Sept.-June	Private houses	Mrs. A. Hamilton, 4 Union Pk., 6-5947
OAKLAND, CAL.	†*EASTBAY A. A.	1st Sat.	8:00	Sept.-June	Chabot Obs.	Miss H. E. Neall, 6557 Whitney St.
OWENSBORO, KY.	†*OWENSBORO A. C.	3rd Sat.	8:00	All year	Public Library	Herman Batt, 1507 Hathaway St.
PALO ALTO, CAL.	*AST. & TEL. CLUB	1st, 3rd Fri.	7:30	All year	Community Center	Marvin J. Vann, 301 Oxford Ave.
PHILADELPHIA	A. A. OF F. I.	3rd Fri.	8:00	All year	The Franklin Inst.	Edwin F. Bailey, *Rit.* 3050
"	*RITTENHOUSE A. S.	2nd Fri.	8:00	Oct.-May	Morgan Physics, U. Pa.	L. C. Green, Haverford College
PITTSBURGH	†*A.A.A. OF P'BURGH	2nd Fri.	8:00	Sept.-June	Buhl Planetarium	Louis E. Bier, 837 Estella St.
PONTIAC, MICH.	*PONTIAC A.A.A.	2nd Thu.	8:00	All year	Private homes	Mrs. M. Chircop, 147 Prospect St., 21455
PORTLAND, ME.	†A.S. OF MAINE	2nd Fri.	8:00	All year	Private homes	H. M. Harris, 27 Victory Ave., S. Portland
PORTLAND, ORE.	†*PORTLAND A.S.	1st Wed.	7:00	All year	Central Pub. Lib.	H. J. Carruthers, 427 S. E. 61 Ave.
"	† A. T. M. & O.'s	2nd Tue.	8:00	All year	Private homes	N. C. Smale, 831 N. Watts St.
PROVIDENCE, R. I.	SKYSCRAPERS, INC.	Mon. or Wed.	8:00	All year	Ladd Observatory	Ladd Obs., Brown U., *GA.* 1633
RENO, NEV.	A.S. OF NEV.	4th Wed.	8:00	All year	Univ. of Nevada	G. B. Blair, University of Nevada
ROCHESTER, N. Y.	ROCH. AST. CLUB	Alt. Fri.	8:00	Oct.-May	Univ. of Rochester	Edwin M. Root, 110 Hamilton St.
SACRAMENTO	SAC. VAL. A. S.	.....	8:00	All year	Sacramento College	S. J. Smyth, 246 41st St.
SAN DIEGO, CAL.	AST. SOC. OF S. D.	1st Fri.	7:30	Oct.-June	504 Elec. Bldg.	W. T. Skilling, 3140 Sixth Ave.
"	†A.T.M. AST. CLUB	2nd, 4th Mon.	7:30	All year	3121 Hawthorn St.	G. A. Sharpe, 4477 Muir, *Bayview* 3757
SCHENECTADY	S'TADY AST. CLUB	3rd Mon.	8:00	All year	Schenectady Museum	G. Staffa, 32 Front St.
SOUTH BEND, IND.	ST. JOS'PH VAL. AST.	Last Tue.	8:00	All year	928 Oak St.	F. K. Czyzewski, South Bend Tribune
SPRINGFIELD, VT.	SPRINGFIELD T. M.'s	1st Sat.	6:00	All year	Stellafane	John W. Lovely, 27 Pearl St., 535-W
ST. LOUIS	ST. LOUIS A.A.S.	1st Sat.	.....	All year	Private homes	A. M. Obrecht, 2913 Park Ave.
TACOMA, WASH.	TACOMA A.A.	1st Mon.	8:00	All year	Coll. of Puget Sd.	Dorothy E. Nicholson, 2816 No. Union Ave.
TEANECK, N. J.	†BERGEN CO. A. S.	2nd Wed.	8:30	All year	Obs., 107 Cranford Pl.	J. M. Stofan, 332 Herrick
TULSA, OKLA.	†TULSA A. S.	Occasional meetings				V. L. Jones, 4-8462
WANTAGH, N. Y.	LONG ISLAND A. S.	Sat.	8:00	All year	Private homes	A. R. Luechinger, Seaford Ave., 1571
WARREN, OHIO	†MAHONING VAL. A.S.	Thu.[4]	8:00	All year	Private homes	S. A. Hoynos, 1574 Sheridan, N.E., 25034
WASHINGTON, D.C.	†NAT'L CAP. AST'MERS	1st Sat.	8:00	Oct.-June	U. S. Nat'l. Museum	L. North, 805 Mt.Vernon Pl. N.W., *Na.* 3377
WICHITA, KANS.	†*WICHITA A.S.	1st Wed.	8:00	All year	To be announced	Dollie Ratcliff, 801 Maple, 2-1822
WORCESTER, MASS.	*ALDRICH AST. CLUB	2nd Tue.	7:30	All year	Mus. Natural History	Ruth Foley, 9 Oberlin St., 63101
YAKIMA, WASH.	YAK. AM. AST'MERS	1st Tue.	8:00	All year	Cha. of Comm. Bldg.	Edward J. Newman, 324 W. Yakima Ave.

[1]June, Jul., Aug., informal meetings. [2]Dinner meeting. [3]Nearest 1st-quarter moon. [4]1st or 2nd Sun., June-Sept.